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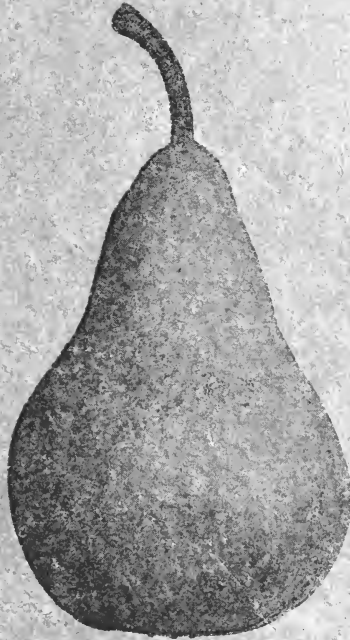


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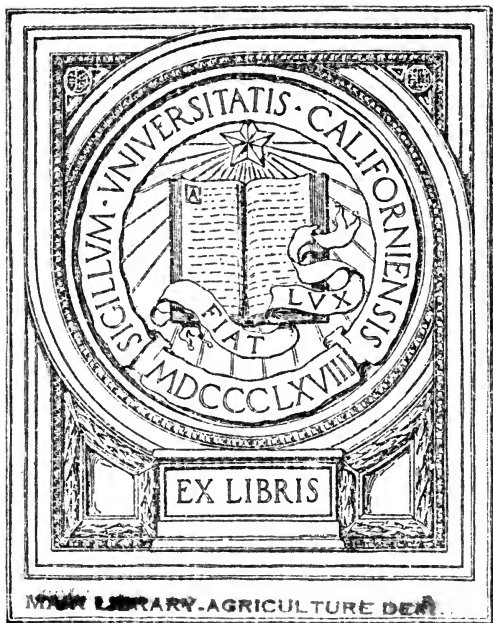
# Pear Growing in California



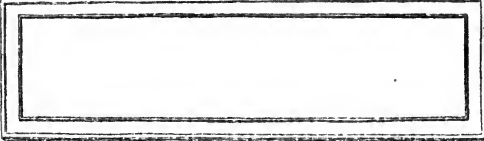
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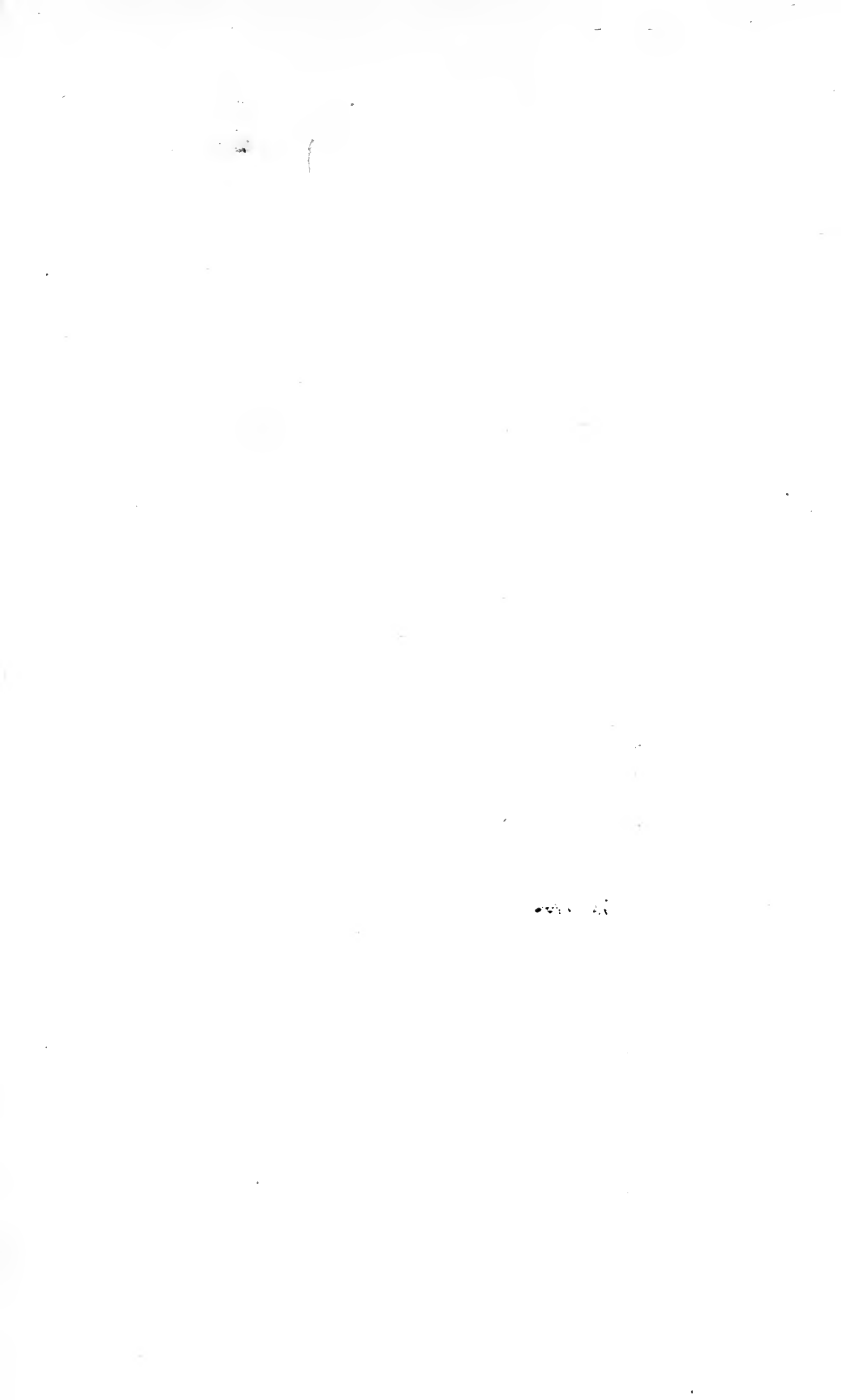
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MAY, 1918.



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THE MONTHLY BULLETIN  
CALIFORNIA STATE COMMISSION OF HORTICULTURE

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VOL. VII.

MAY, 1918.

No. 5.

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# Pear Growing in California

A Practical Treatise Designed to Cover  
Some of the Important Phases of  
Pear Culture Within the State

BY

GEO. P. WELDON

Chief Deputy State Commissioner of Horticulture

Entered as second-class matter December 29, 1911, at the post office at Sacramento, California, under the act of June 6, 1900.

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## FOREWORD.

The appearance of pear blight in the Sacramento and San Joaquin valleys some twenty years ago resulted in the destruction of a large acreage of the best pear orchards of California. Resolute action in the adoption of proper control measures brought about a rapid recovery of confidence in the future of this industry, and since that time most encouraging progress has been made in the practical application of remedies in the control of pests and diseases, in the study of resistant rootstocks, in better handling of the crops, and in bettering market conditions. Today California stands indisputably at the head of the world's pear growing districts, both in quantity and quality of the fruit produced.

The need of a good reliable handbook on the pear industry of the state has been very evident for some time, and Mr. George P. Weldon, Deputy Commissioner of the State Commission of Horticulture, has been charged with the investigation of conditions, and after much patient and careful research work has completed such a manual. The extensive experience Mr. Weldon has had in this and other states has especially fitted him for this work, and I am sure that this publication will be welcomed and appreciated. It is hoped that it may be of service to those actually interested in the upbuilding of this industry, which is certain to remain one of the largest fruit specialties in California.

G. H. HECKE,

*State Commissioner of Horticulture.*

Sacramento, California, May 1, 1918.

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## PREFACE.

During the time spent in the investigation of the pear industry, covering a period of four years, in practically every county of the state where this fruit is grown commercially, the writer was extended many courtesies and received much valuable assistance from the county horticultural commissioners, and therefore wishes to express to them his appreciation and thanks.

In the preparation of the manuscript the valuable aid of a number of people familiar with the pear industry was secured. To them points that were uncertain were submitted for an opinion, which was always generously and freely given. The publication of this book is thus undertaken with an added assurance that the material contained in its pages is reliable. The thanks of the author is tendered to Mr. A. L. Wisker, Grass Valley, California, for revising manuscript, aiding with the description of varieties, and for furnishing a table giving dates of blooming for different varieties; to Dr. W. L. Howard, Professor W. P. Tufts and Professor A. H. Hendrickson, of the University of California, for aid in the description of varieties and data on cross pollination; to Professor C. I. Lewis, Corvallis, Oregon, Mr. W. V. Eberly, Niles, California, and Mr. George C. Roeding, Fresno, California, for data on varieties; to Professor F. C. Reimer, Talent, Oregon, and Mr. A. C. McCormick, Talent, Oregon, for revising the article on pear blight and for data regarding varieties; to Mr. F. C. Brosius, County Horticultural Commissioner, Sacramento, California, for data on intercrops and production; to H. S. Smith, Superintendent of the State Insectary. D. C. Fessenden, Secretary of the State Commission of Horticulture, O. W. Newman, Assistant Secretary of the State Commission of Horticulture, and Miss Edith Moore, stenographer in the State Commission of Horticulture, for much painstaking work in correcting proof.

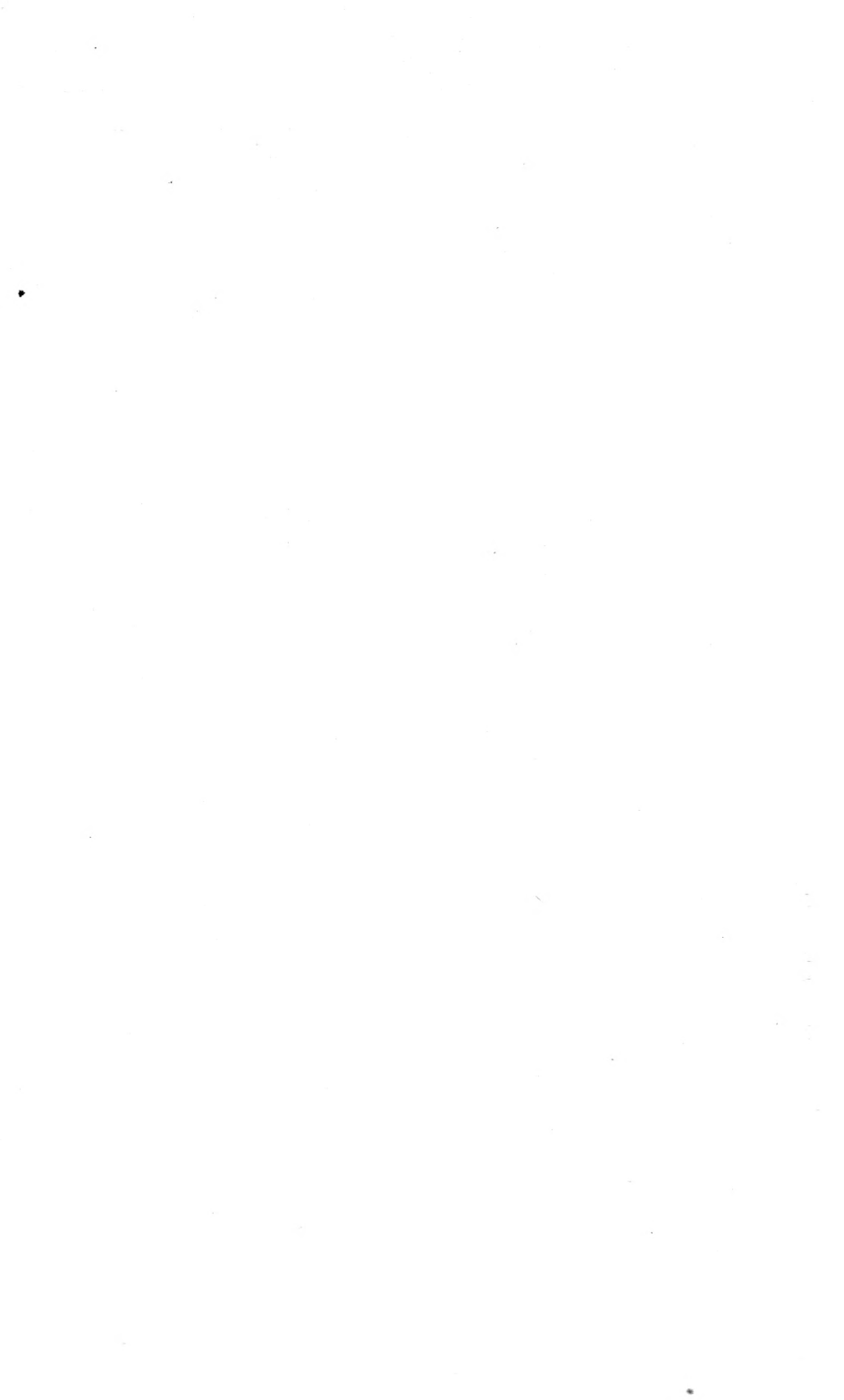
The work was done under the immediate direction of State Horticultural Commissioner G. H. Hecke, whose valuable suggestions have at all times been available and have meant much toward the satisfactory completion of the book.

GEO. P. WELDON.





BARTLETT



## CHAPTER I.

## INTRODUCTION.

Pear growing in California dates back over a period of approximately one hundred and fifty years, although commercially the industry amounted to little until more than a century later. The first trees were planted by the Franciscan Fathers on the grounds of their various missions, including Mission San Jose in the Santa Clara Valley. Strange to say, this valley which witnessed the beginning of the pear industry in the state has, up to the present time, been absolutely free from blight, the scourge of the pear orchard, which has spread throughout practically all other pear-growing sections in the United States and which has made the growing of this fruit unprofitable, if not impossible, without the application of extreme measures in its control. Fig. 1 shows



FIG. 1. Pear trees growing near Santa Barbara, where they are said to have been planted by the Padres about 125 years ago.

some very large seedling pear trees at Gaviota, Santa Barbara County, California, which are said to be at least 125 years old. The largest tree is about three feet in diameter and at least 45 feet high. They are very thrifty and except at close range look like oaks. Apparently blight has never affected them in the least. At San Rafael there are some old seedling trees which are said to have been planted in 1817. These are also hardy and free from blight.

Since the days when the Padres demonstrated the adaptability of the pear and other fruits to California conditions, on the lands surrounding the missions, many of which are still standing amidst remnants of these old tree plantings, the pear industry has assumed such proportions that it is now one of the leading deciduous fruit

industries of California. During the year 1916, according to the best available figures, there were 17,764 acres of pear trees in bearing and 23,325 acres that had not yet come into bearing in the state. In 1917 the bearing area was increased to 20,473 acres and the nonbearing to 28,069 acres. During 1917 there were shipped from the state 4,798 carloads of pears.\* In addition there were dried in Lake County alone the equivalent of 3,981 tons green fruit. The total production of shipping, drying and canning pears was approximately 90,000 tons.

At the present time the leading pear-growing county of the state is Sacramento, where the production in 1917 was 26,669 tons. The Santa Clara Valley, the "cradle" of the commercial industry, is still an important section for the growing of this fruit. It is in this valley that many other varieties besides the Bartlett have been successfully produced. The latter is, however, by far the most important variety grown in the state and California is noted because of the splendid quality and quantity of Bartletts, which, either fresh, canned or dried, are known in all the principal markets of the world.

The table to be found on a succeeding page of this chapter, which shows the acreage of pears in each of the counties where the industry is at all important, illustrates the fact that there are possibilities in the



FIG. 2. Typical scene in the pear orchard section of El Dorado County.

growing of this fruit that have never yet been realized. In the foothills of the Sierras, where the first plantings were made by the pioneers of the gold mining days; in the coast valleys and in the hills of the coast range of mountains from Eureka to Santa Barbara; in the fertile valleys of the Feather, Sacramento, San Joaquin and other inland rivers; and in the desert sections of the south, including the Imperial Valley, where they are growing below the level of the sea, planting has been going on and pears are being produced successfully, upon a commercial basis. Available land for profitable pear culture may be found in practically every county of the state, and when we consider the pos-

\*Figures from California Fruit News of December 29, 1917.

sibility of development we are forced to ask ourselves the question—"Can the business be overdone?" This question can not be directly answered and involves so many things that we can do little more than speculate. Suffice it to say here that California's soil and climatic conditions are such that in spite of difficulties which have driven other sections out of the business our growers have succeeded. Most important of these difficulties with which other states have not been able to cope are frost and blight. The assurance of practically annual crops is necessary in order that there may be justification for the expenditure of large amounts of money in the fight to control pear blight. Cali-



FIG. 3. Orchard scene in the "Southern California Desert Region" near its northern extremity in Kern County.

ifornia pear growers are extremely fortunate in this respect and in many sections there is little thought of any injury from spring frosts, and while each year's crop varies in its size, there is nearly always an abundance of fruit. In a few places the frost hazard must be reckoned with, and orchard heaters can sometimes be used to good advantage.

An attempt was made, in the preparation of this work, to gather figures on the acreage of pears grown in other states of the Union which were rated as being of considerable importance as far as this industry is concerned. As a basis for estimates the census figures of 1910, showing the acreage of pears in the various states of the Union during that year were taken. A letter was written to some noted horticulturist or to an experiment station director in each of these states, and a request was made for information as to the present acreage in pears in comparison with that given in the census report for 1910. It is a very significant fact that without a single exception the answers that came to us from the eastern and middle western states showed that the acreage of pears had either remained the same or had decreased rather than increased since 1910, and that the decrease was due to the ravages of blight and the inability of the growers to control the disease. As an

illustration of this fact a very significant letter came from C. S. Crandall, professor of pomology in the University of Illinois, which we quote from as follows:

“From 1900 to 1905 there was a craze, in the southern part of the state, for planting orchards of Kieffer pears under the belief that this variety was immune to blight and under the stimulus of good crops produced in some orchards planted ten or twelve years previously. But these orchards have gradually succumbed to blight and it is my belief that the number of existing trees is very much less than the number indicated in the census returns for 1910.

“For the last ten years our Horticultural Society Reports mention the pear only in connection with efforts to control blight and during this period there has been little, if any, planting for orchard purposes. Doubtless a few trees are planted every year in home gardens, but, in general, there is no interest in this fruit. There are, here and there, old trees that are still free from blight and bearing crops and it is possible that there are a few isolated small orchards still in productive condition, but as an orchard crop the pear is not now receiving any attention from fruit men.”

No less striking cases of decrease in the acreage of pears in other states than that given in Professor Crandall's letter are cited in letters from Professor L. R. Taft, State Inspector of Nurseries and Orchards, East Lansing, Michigan; and Professor Wendell Paddock, horticulturist of the Ohio State University, Columbus. We quote from Professor Taft's letter as follows:

“The general crop report of the Secretary of State gives the number of trees in bearing as 909,200. During the last eight years a large number of trees have been taken out owing to the injury from pear blight or because they have not been found profitable. On the other hand comparatively few trees have been planted.”

The census of 1910 showed the number of bearing trees in Michigan to be 1,136,151.

Professor Paddock states in his letter that “blight has been very severe in the state of Ohio for the past three years, with the result that a great many pear trees were killed and many others have been destroyed by the owners, so our number of pear trees has been very much depleted.” \* \* \* “I doubt very much whether there are 100,000 able-bodied pear trees of all descriptions in this state.” The census report of 1910 shows that at that time there were 899,019 bearing pear trees in the state of Ohio.

The only states of the Union where the pear industry is on the increase rather than the decrease are California, Oregon and Washington. New York, which leads in acreage, with 2,141,596 bearing trees, has apparently held its own since the census of 1910, according to the best available figures. California has increased since that time from 1,410,996 bearing trees to 1,894,300 and ranks next to New York in the number of acres of pear orchards. While accurate figures could not be secured on bearing acreage in Oregon, it is probable that she ranks third, Michigan having practically the same acreage.

The effect of blight in limiting planting in other states has also had a similar effect, but in a lesser degree, in California. Thus, while our acreage has greatly increased since the year 1910, many have not planted because of the fear of blight and the possibility of losing an orchard from this disease after the expense of planting and caring for it during a few years of its life.

Another significant fact regarding the pear industry, especially of the south and middle west, is that it has been a failure despite the fact that the Kieffer variety, which is much more resistant to blight than the Bartlett, has been grown. Such failure can only be attributed to the fact that the growers have not made the effort characteristic of the California pear growers in the fight against this disease. While we should not glory in others' misfortune there is little doubt that the failures of the pear growers in other states have had a beneficial effect upon the industry in this state, and a better market and better prices have come about because of scarcity of a cosmopolitan fruit, the production of which has been limited by the attack of a fatal disease.

TABLE SHOWING THE ACREAGE OF PEARS IN CALIFORNIA BY COUNTIES IN 1917.

County	Acres of pears		County	Acres of pears	
	Bearing	Non-bearing		Bearing	Non-bearing
Alameda -----	800	250	Riverside -----	405	596
Butte -----	225	270	Sacramento -----	3,300	1,700
Colusa -----	40	20	San Benito -----	147	768
Contra Costa -----	850	1,250	San Bernardino -----	202	998
El Dorado -----	500	1,000	San Diego -----	118	429
Glenn -----	40	600	San Joaquin -----	402	256
Humboldt -----	50	60	San Luis Obispo -----	141	2,439
Imperial -----	82		Santa Barbara -----	20	
Inyo -----	250	450	Santa Clara* -----	1,530	223
Kern -----	190	1,075	Santa Cruz -----	50	400
Lake -----	600	2,000	Shasta -----	100	31
Los Angeles -----	534	5,450	Siskiyou -----	45	15
Madera -----	15	15	Solano* -----	1,000	230
Marin -----	50	90	Sonoma -----	1,150	555
Monterey -----	105	100	Stanislaus -----	232	6
Mendocino -----	450	1,100	Sutter -----	109	83
Mered -----	100	20	Tehama -----	680	154
Modoc -----	28	4	Yolo -----	975	792
Napa -----	500	500	Yuba -----	495	1,100
Nevada -----	700	2,400			
Orange -----	25		Totals -----	19,233	28,069
Placer -----	2,000	610			

\*1916 figures.

#### COST OF BRINGING AN ORCHARD INTO BEARING.

The prospective pear grower frequently wishes to secure accurate information as to what it will cost to plant an orchard and bring it into bearing. Figures of this kind must necessarily vary with locality and it is exceedingly hard to secure information along this line. The following estimate of the cost of developing a 20-acre orchard of pears in the foothill region of Butte County was written for a recent number of the Monthly Bulletin by Mr. E. Meriam, of Paradise, California:

"The land when purchased was rough land. Nearly the entire work was done by hired men and teams, day work, often not immediately superintended. The wages were usually \$2 for nine hours' labor, and \$4 for man and team. Not much personal time was given to the work, so no account was kept of it. However, it would be fair to add 10 per cent to the cost for personal labor. (If any one should use these figures as a basis for his own operation, if he intends to do his own work, he should deduct 10 per cent because an owner usually works more intelligently and harder than an employee.)

"The land was covered as follows: Ten acres in native forest of fairly heavy growth oak, pine and manzanita, and ten acres in stumps and logs with a second growth manzanita, which required mattocks to remove. The removal of rocks was not an important item of expense, possibly \$50. In the spring of 1913, as many men were employed as possible to clean the land quickly, and especially to cut the marketable wood, with the expectation that the wood would pay in large part for the clearing. This worked out very satisfactorily.

"By June, 1914, the rough land was sufficiently cleared to permit plowing half of it and the setting of 1,000 trees. The next year, in January, 1915, the remainder of the 20 acres was planted. There are now on the place 850 pear trees, 850 apples and 100 border trees of cherry and walnut. These trees are vigorous and of good size for their age. The items of expense which remain until trees come into bearing consist of cultivation and plowing. For this \$200 a year will undoubtedly be sufficient. The actual expenditures to date (March 1913-August, 1916), are as follows:

"COST OF LAND AT \$50 PER ACRE.....		\$1,000 00
Blasting powder.....	\$49 90	
Tools for clearing.....	9 60	
Wood cutting and clearing.....	717 30	
Wood hauling to market.....	371 90	
Incidentals in clearing.....	2 60	
		<u>1,151 30</u>
		\$2,151 30
PLANTING THE ORCHARD.		
Rabbit-proof fence and construction.....	\$121 15	
Orchard tools.....	15 20	
Cost of trees (best of their kind).....	218 35	
Tree planting (entire process).....	261 45	
		<u>616 15</u>
CARE OF ORCHARD.		
Plowing and cultivating.....	\$211 50	
Lime for whitewash, etc.....	3 00	
Pruning (largely done by self).....	5 75	
		<u>220 25</u>
Total cost, including land.....		\$2,987 70
Received for wood.....		<u>906 10</u>
Net expenses, exclusive of personal service.....		\$2,081 60"



## COST OF PRODUCTION OF FULL-BEARING TREES.

In 1914 Deputy County Horticultural Commissioner of Sacramento County, Mr. F. C. Brosius, prepared an article for the Monthly Bulletin of the State Commission of Horticulture on the cost of producing pears, from 25 to 40-year-old trees in an orchard containing 1,000 bearing trees. The following table is copied from the article as published at that time. It contains much information which is of interest as well as of much value to the pear grower:

"Yield From 1,000 Pear Trees, 25 to 40 Years Old, 189 Tons or 7,000 Packed Boxes.

CULTURAL COST.	
Pruning, one man, 7 trees per day, at \$1.75, or 25 cents per tree-----	\$250 00
Pear blight pruning in spring, at 20 cents per tree-----	200 00
Plowing, one man, one acre per day, at \$2.25 per day-----	43 00
(6½ acres, 3 cultivations, 19 days)	
Pumping, irrigating on 6½ acres, at \$7.50 per acre, per season-----	47 50
Hauling from orchard to packing shed, one man, 19 days and \$2.25 per day-----	42 75
Two tons fertilizer, at \$38.00 per ton-----	76 00
One team, 130 days, cultivating, spraying, hauling, etc., feeding at \$1.00 per day-----	130 00

## COST OF SPRAYING.

For thrips:		
22 gallons distillate per tank, at 18 cents per gal., or		
30 trees-----	\$3 96	
One pint black leaf "40" per tank, or 30 trees-----	1 25	
	<u>5 21</u>	
Or 17 cents per tree for spraying 1,000 trees twice in season-----		340 00
For codling moth and thrips:		
12 pounds lead arsenate per tank, or 30 trees, at-----	\$1 20	
One pint black leaf "40" per tank, or 30 trees-----	1 25	
	<u>2 45</u>	
Or 9 cents per tree for spraying 1,000 trees three times in season--		270 00
For pear scab:		
500 pounds lime-sulphur spray, at 7½ cents per pound-----		36 25
(One special spraying and one combined with codling moth spray)		
Labor:		
Three hose men, one driver, at \$2.25 per day; 5 tanks, or 150 trees per day, 4 sprayings in season of 42 days-----		378 00

## PICKING AND PACKING.

Picking:		
One man, 30 boxes per day, at \$2.25, or 7½ cents per box, 7,000 boxes-----		525 00
Shook, nails, paper, 12 cents per box, 7,000 boxes-----		840 00
Making boxes and packing, 6 cents per box, 7,000 boxes-----		420 00
Total cost of production-----		<u>\$3,598 50</u>

## RECEIPTS.

189 tons, or 7,000 boxes, at \$1.10 net-----	\$7,700 00
Deduct cost of production-----	3,598 50
Balance -----	<u>\$4,101 50"</u>

The above estimate of the cost of production was made at a time when labor was more plentiful and much cheaper than at the present time. However, the average is believed to be fair. This case is a striking illustration of the amount of money that it is sometimes necessary to invest in order to make an orchard pay for itself. Without spraying, pruning, cultivation and all those things which go toward making a success of an orchard such profits could not possibly be made.

**PRODUCTION AND PRICES.**

It will be seen that the production of this particular orchard was about 28 tons per acre. This is an exceptionally high yield and is away above the average, for even in the Sacramento Valley, where trees produce more than in any other section of the state, the average would not be higher than 10 tons per acre. Prior to beginning the preparation of this bulletin a questionnaire was sent to a number of the leading pear growers of the counties where the production of this fruit is of considerable importance and 65 of the total number written replied to the questionnaire. In answer to a question regarding the average production of bearing orchards these growers estimated 10 tons per acre to be a fair average. This is not at all an impossible amount for the better pear-growing sections. The average yield throughout the entire state, however, would be much lower than this and possibly not more than one-half of this amount, or 5 tons per acre. The average maximum yield, as reported by the same 65 growers, was 23 tons per acre and the average age of the trees reported upon was 18 years.

Prices received for the earlier pears are always satisfactory and \$3.50 per box is not an exceptionally high price for the first Bartletts of the season. The average price for Bartletts throughout the season would probably not be more than \$1.30 per packed box. Authentic figures from one locality show this amount for a ten-year average. Like the very early pears, those that are very late, and as a consequence reach the market at a time when the early fruit has all been sold, frequently bring a much higher price than the average. The canneries pay from \$35 to \$50 per ton for fruit for canning purposes. Other varieties, such as Winter Nelis, Comice, Anjou and Bosc, often sell for fully as good, if not better, prices than Bartletts. Winter Nelis, being a late variety and thus supplying the market after the other varieties mentioned are gone, nearly always bring a very satisfactory price.

**PEAR REGIONS OF THE STATE.**

As the pear is very generally grown, and as there are more or less well-defined areas where orchards may be found, the state has been divided into eight regions. These, with a definition of their limits, are as follows:

*Northern California Coast Region*—All Coast Range counties or portions of counties from the northern boundary of the state to the northern line of Sonoma and Napa counties.

*Central California Coast Region*—All Coast Range counties or portions of counties from the northern boundary of Sonoma and Napa counties to the northern boundary of Santa Barbara, Ventura and Los Angeles counties.

*Southern California Coast Region*—All counties bordering on the Pacific from the northern line of Santa Barbara, Ventura and Los Angeles counties to the southern line of the state.

*Northern and Central California Interior Valley Region*—All interior counties or portions of counties, included in the Sacramento, San Joaquin and other inland river valleys from the northern boundary of Tehama County to the Tehachapi Mountains.

*Southern California Desert Region*—The dry desert sections of Kern, Los Angeles and San Bernardino counties.

*Imperial Valley Region*—The low, arid, hot agricultural sections of Riverside and Imperial counties.

*Sierra Nevada Foothill and Mountain Region*—All counties or portions of counties in the foothills or mountains proper of the Sierra Nevada Range on the western slope.

*Modoc-Inyo Region*— All sections east of the Sierra Nevada Mountains in California possessing the rigorous climate of Modoc County on the north and Inyo on the south.

## CHAPTER II.

## VARIETIES.

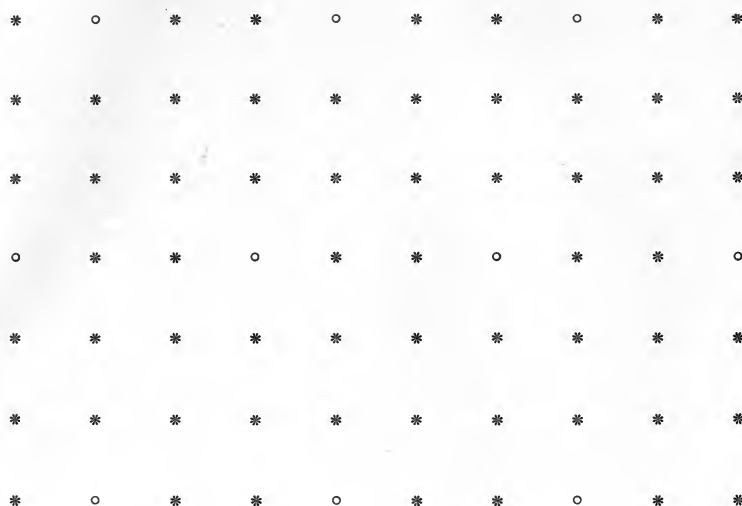
In California where most of the pear acreage is of one variety and where the average planter thinks only of the Bartlett when he considers the planting of a commercial orchard, there may be those who would consider a discussion of other varieties superfluous. Admitting that the Bartlett is best for general-purpose planting in the state, the question is exceedingly important from the standpoint of data regarding varieties that are well adapted for cross-pollination purposes. The Bartlett in California is generally considered to be self-fertile. While it is a fact that it is self-fertile to the extent that large areas will produce well year after year with no other varieties close by from which they might receive the benefit of pollen other than their own, this variety, along with all other varieties of pears, is considered in most locations to be practically self-sterile, and is not recommended for planting in blocks by itself. Thus we find the two conditions represented by self-fertility in one section, and self-sterility wholly or in part in another, and the only reason we can assign for this state of affairs is that when grown where every condition is favorable Bartlett is self-fertile in a certain degree; in the absence of certain factors which have not been determined it is more or less self-sterile. Between the two extremes of self-fertility and self-sterility we can imagine innumerable degrees of fertility, and possibly in California, where the Bartlett is thought to be self-fertile and where uniformly good crops are produced year after year remote from other varieties, it possesses a high degree of fertility with the possibility of an increase to a still higher degree when subjected to the influence of foreign pollen. There is considerable evidence to substantiate this theory. Warren P. Tufts of the University of California Farm School at Davis, in a recent letter gave the following information:

“Experiments on rather a small scale have been conducted by the writer during the past two seasons in the University Orchards at Davis. The results of these tests seem to indicate that the Bartlett under the interior valley conditions of California will set a comparatively light crop with its own pollen, but that if interplanted with the proper varieties, the per cent of blossoms setting fruit will be increased five or six times. From conversation with growers in the Sacramento Valley, I find that it has also been their observation that Bartlett pears in close proximity to other varieties regularly set a larger crop than other trees farther removed from the interplanted pollinizers.

“Under conditions existing in the foothills, progressive and observing growers commonly regard interplanting of pear varieties for purposes of cross-pollination absolutely essential.

“Taken on the whole, I am inclined to believe that in the valleys of California and assuredly in the foothills, interplanting of varieties will yield goodly returns. Naturally, the valley grower will want to plant as many Bartletts and as few pollinizers as possible.

There is little definite information on this point, although we do know that the influence of pollinizers varies inversely with the distance. In order to secure efficient pollination with the fewest possible pollinizers, I would recommend 1 to 7 or 8 and would place the pollinizers as every third tree in every third row, in such a way that the spaces in the pollination rows are broken, thus:



In substantiation of Mr. Tufts' conclusions, the writer knows of one large pear orchard which has growing in it a few Winter Nelis trees. The owner of the orchard has pointed out to me the load of fruit on surrounding Bartletts, which is considerably heavier than in other parts of the orchard. Every year it is said these Bartletts are the heaviest producers in the orchard. One exceedingly interesting case of increased productivity of the Bartlett through cross-pollination is found in the experience of Mr. A. L. Wisker at Grass Valley. In experimenting with many different varieties of pears, Mr. Wisker had occasion to graft over a portion of a block of old trees containing only Bartletts, to a miscellaneous lot of other varieties. In 1913, according to Mr. Wisker's statement, 31 of the Bartlett trees that were left in the block bore 13 boxes of marketable pears. With eight other varieties in bloom during the season of 1914, 26 boxes were produced. In 1915, with over fifty varieties blooming, the production of these same 31 trees was 78 boxes of marketable pears and 30 boxes of culls, the latter because of blister mite attack. As the trees are over fifteen years of age the difference in the amount of fruit produced during the three successive seasons could not be attributed to the increase in age, and can only be accounted for by the beneficial effect of the pollen from the other varieties which were introduced into the orchard by grafting.

\*Bulk of planting.  
°Pollinizer.

A careful investigation of the subject of cross-pollination in the state would no doubt show that these two cases cited are in no way exceptional and that the best results in growing Bartlett pears can not be attained unless other varieties are planted with them in the orchard. Despite the evidence that this should be done, there are thousands of acres of Bartletts being planted in California each season with utter disregard of the benefits that might be derived by planting one or more varieties of another sort for cross-pollination. In certain new pear-growing sections, the writer has recently seen thousands of acres of Bartletts in blocks of five acres to more than one hundred acres each, with no other varieties near, except possibly an occasional tree of some favorite pear planted for home use. In some of these sections heavy winds and extremes of heat and cold occur, making more necessary the strictest attention to every detail that would tend to increase productivity. The fruit in general is good, and the trees everywhere have done well. As far as it has been possible to determine, they are self-fertile to a remarkable degree when the existing conditions are taken into consideration, but it is safe to predict that there will be years of short crops because of the absence of other pears, and the average production of these sections throughout a series of years will be far below what it would be with other varieties planted along with the Bartletts for cross-pollination purposes. There are older pear-growing sections of the state where large areas of Bartletts have been planted by themselves and where the same arguments against the practice may be used.

Without doubt, there will be those who will take exception to this discussion on the need for pollinizers in the Bartlett orchard, and, in defense of the system of planting this variety alone, will point to the many good orchards in the state which have paid their owners a good profit year after year. In answer, we can only say that while this is true the evidence all points to the beneficial effect of cross-pollination, and such orchards would have yielded uniformly better crops during the same period of time and a greater production from a lesser number of trees had other varieties been interplanted.

A knowledge of the value of pollinizers for interplanting with the justly popular Bartlett makes it desirable that other varieties be carefully tested in the different pear-growing regions of the state in order that the best commercial varieties that are good pollinizers may be determined. There is need for carefully-planned experiments along this line and the task is one that would require a great many years' labor. Already something has been done. The California Nursery Company at Niles has a test block of more than 80 varieties, while Mr. Wisker has 80 varieties in his experimental orchard at Grass Valley. The state is fortunate in having these two splendid experimental orchards and in time better varieties than we have yet known may be found; at least better from the standpoint of something that is well adapted for planting with the Bartlett.

The most popular variety for this purpose at present is the Winter Nelis, and in many of the older orchards where some attention has been paid to interplanting, this variety has been found. Hardy and Easter Beurre have been used quite extensively in the past but most of the trees of these varieties have in late years, been grafted to Bartlett.

For the best results in the cross-pollination of varieties it is necessary to select those that bloom at approximately the same time. The following table, which was prepared by A. L. Wisker, shows the time of blooming of a number of different varieties for the years 1915 and 1916, also the dates when these varieties were in full bloom during the same two seasons. This list contains many of the varieties which are commonly grown:

TABLE SHOWING DATES OF FIRST BLOOM AND FULL BLOOM.

	First bloom		Full bloom	
	1915	1916	1915	1916
Alencon	Mar. 25	Mar. 12	April 4	Mar. 15
Angers	April 7	Mar. 17	April 11	-----
Angouleme	April 1	Mar. 14	April 8	Mar. 17
Anjou	April 2	Mar. 14	April 10	Mar. 20
Bartlett	April 4	Mar. 14	April 16	Mar. 19
Bloodgood	April 1	Mar. 13	April 10	Mar. 17
Bordeaux	April 8	Mar. 15	April 12	Mar. 21
Bosc	-----	Mar. 17	-----	Mar. 24
Boussock	April 7	Mar. 14	April 11	Mar. 20
Bretonneau	Mar. 25	Mar. 14	April 4	Mar. 18
Cardinal	Mar. 29	Mar. 12	April 8	Mar. 17
Clairgeau	Mar. 30	Mar. 14	April 8	Mar. 18
Clapp Favorite	-----	Mar. 16	-----	Mar. 20
Columbia	April 5	Mar. 15	April 10	Mar. 22
Comice	April 5	-----	April 11	-----
Congress	April 6	Mar. 16	April 10	Mar. 20
Dearborn Seedling	Mar. 31	Mar. 13	April 8	Mar. 17
Diel	April 3	Mar. 14	April 10	Mar. 20
Dix	April 3	Mar. 16	April 9	Mar. 19
Flemish Beauty	April 7	Mar. 15	April 11	Mar. 22
Forelle	Mar. 29	Mar. 12	April 8	Mar. 17
Gaillard	Mar. 30	Mar. 14	April 8	Mar. 17
Gansel's Bergamot	April 2	Mar. 12	April 9	Mar. 17
Giffard	April 1	Mar. 14	April 7	Mar. 17
Glout Moreau	April 4	Mar. 15	April 9	Mar. 22
Gris d'Hiver	Mar. 31	Mar. 13	April 8	Mar. 16
Hardy	April 6	Mar. 14	April 10	Mar. 18
Howell	Mar. 31	Mar. 13	April 8	Mar. 16
Idaho	April 8	Mar. 15	April 12	Mar. 19
Joan of Arc	April 7	Mar. 16	April 11	Mar. 21
Kieffer	Mar. 23	Mar. 11	April 3	Mar. 15
Lawrence	April 1	Mar. 13	April 8	Mar. 17
Lawson	-----	Mar. 12	-----	Mar. 17
Le Clerc	April 2	Mar. 15	April 12	Mar. 21
Le Lectier	April 5	Mar. 14	April 8	Mar. 20
Louise Bonne	-----	Mar. 13	-----	Mar. 18
Lucien Chaire	April 7	Mar. 17	April 11	Mar. 21
Madeleine	April 2	Mar. 13	April 9	Mar. 16
Margarst Marillat	April 2	Mar. 14	April 9	Mar. 18
Marshall	-----	Mar. 15	-----	Mar. 20
Mt. Vernon	Mar. 30	Mar. 13	April 6	Mar. 18
Onondaga	April 7	Mar. 16	April 12	Mar. 22
P. Barry	April 2	Mar. 14	April 8	Mar. 19
Philopena	April 2	Mar. 13	April 8	Mar. 16
Poitau	April 8	Mar. 18	April 15	Mar. 26
Rossney	April 5	Mar. 17	April 10	Mar. 21
Seckel	-----	Mar. 14	-----	Mar. 19
Summer Doyenne	April 1	Mar. 14	April 9	Mar. 17
Superfin	April 5	Mar. 14	April 10	Mar. 19
Touraine	Mar. 30	Mar. 15	April 8	Mar. 21
Urbaniste	-----	Mar. 14	-----	Mar. 20
Vanille	April 1	Mar. 15	April 9	Mar. 18
Vicar	April 2	Mar. 16	April 8	Mar. 21
Vienne	Mar. 30	Mar. 13	April 8	Mar. 17
White Doyenne	April 6	Mar. 15	April 10	Mar. 20
Winter Bartlett	-----	Mar. 16	-----	Mar. 22
Worcester	April 6	Mar. 15	April 11	Mar. 21
Zoe	Mar. 30	Mar. 13	April 7	Mar. 18

## LEAF CHARACTERISTICS OF VARIETIES.

The studies made during the course of preparation of this bulletin revealed some interesting facts regarding the leaf characteristics of species and varieties of pears. Each species, as would naturally be expected, possesses an entirely different form of leaf, by means of which its identification wherever the species might be found would be practically certain. The variation is much greater than would be supposed by those who are not familiar with a number of different species. The leaves shown in Figs. 4 and 5 illustrate this point clearly. In *Pyrus*



FIG. 4. Leaf of *Pyrus heterophylla*.



FIG. 5. Leaf of *Pyrus variolosa*.

*heterophylla* is found the extreme type of lobed leaf. This leaf has little to suggest that it belongs to a pear tree. The other has more of the characteristic shape of the cultivated varieties. The serration is more prominent in most of the wild species than in our cultivated varieties. The serration furnishes one of the important identification characteristics. In some varieties there occurs a small, regular serration as in Bartlett; in others it is irregular. Certain varieties, *e. g.*, Winter Nelis, Anjou and Bosc, have practically no serration, although the leaf margins may be more or less wavy. The general shape of the leaf differs markedly with different varieties and while there is a wide variation between individuals on the same tree, it is not difficult to pick the common shape that is characteristic of the variety. The apex and stem also furnish distinguishing characteristics. Here, again, the variation is sometimes confusing but the characteristics that most of the leaves possess soon become fixed in one's mind as he studies them. Contrary to expectation, the length of petiole is so variable that little stress can be laid upon this characteristic as an aid in the identification of varieties. For example, the length of petioles of leaves of the Winter Nelis variety collected at Niles and at Lakeport varied from



an average length of .96 inches in the former case to 1.57 inches in the latter. More striking still is the difference found in the case of Winter Bartlett. The stems of leaves collected at Yucaipa averaged  $1\frac{3}{10}$  inches; of leaves collected at Niles  $2\frac{1}{2}$  inches; of leaves collected at Tehachapi  $1\frac{1}{10}$  inches. It is possible that characters of venation could be used to advantage in more or less technical descriptions of leaves. From a practical point of view it was not considered important to take up a study of the venation. The other characters mentioned are all extremely important and are illustrated as well as possible in the pictures of leaves shown along with the fruit of a number of the more common varieties. An attempt was made in each case to pick out a leaf that was as nearly characteristic of the variety as was possible. In some cases it was difficult to find a leaf at the time of photographing that would take well and that would be representative, but on the whole it is believed that fairly accurate photographs have been secured. Leaves of practically every variety described were gathered in many different orchards and localities of California, and in the case of a few varieties and species samples were also collected in Oregon and Colorado. Having made collections so generally and having found only a very slight variation in general characters in widely separated localities, the conclusion is reached that the types of leaves shown will prove valuable as an aid in the identification of varieties. Relationships not known to exist between different varieties are frequently suggested by leaf characters. In the case of those that are known to exist the leaf characters of one or the other parent are readily distinguished. For example, the Kieffer is known to be a cross between the Bartlett and *Pyrus serotina*. A comparison of the leaf with that of *Pyrus serotina* at once suggests Japanese pear parentage. The deep, prominent serration of the Japanese stock has been replaced in the hybrid by a type of serration not unlike the Bartlett. The Le Conte variety, which is a hybrid as a result of a cross between the Japanese pear, *Pyrus serotina*, and the European pear, *Pyrus communis*, plainly shows its Asiatic parentage in the general shape of the leaf, especially in the long apex, while the European parentage has manifested itself in a broadening of the apex, and in a serration very much like that of *Pyrus communis*.

In the description of fruits the scheme followed is quite similar to that used by such men as Downing. More stress than usual has been laid upon the calyx characteristic as to whether it is open or closed. Here, again, there is some variation with locality but in general a variety has either an open or a closed calyx and this characteristic, in conjunction with the size and shape of the basin, is considered to be of vital importance in identifying varieties. The length of stem is a more constant character than in the case of leaves, and wherever possible accurate measurements were made of several specimens of each variety and a fair average length decided upon. The general shape of each is quite characteristic and the occurrence of green or brown dots is common. The illustrations of varieties show the general type in each case where it was possible to secure samples for photographing. The serration characters have, in a few cases, been destroyed in the routing of the cuts.

## DESCRIPTIONS OF VARIETIES.

**Angouleme.**

Origin France. Size large. Color greenish yellow with russet. Shape wide, obtuse pyriform. Calyx closed or partly closed. Basin narrow and rather deep. Stem heavy, 1 to 1½ inches long. Cavity flat and wide. Quality good. Rather coarse grained but sweet, juicy, buttery and pleasant in flavor; rather strong. This variety is said to do best when



FIG. 6. Leaf of Angouleme.

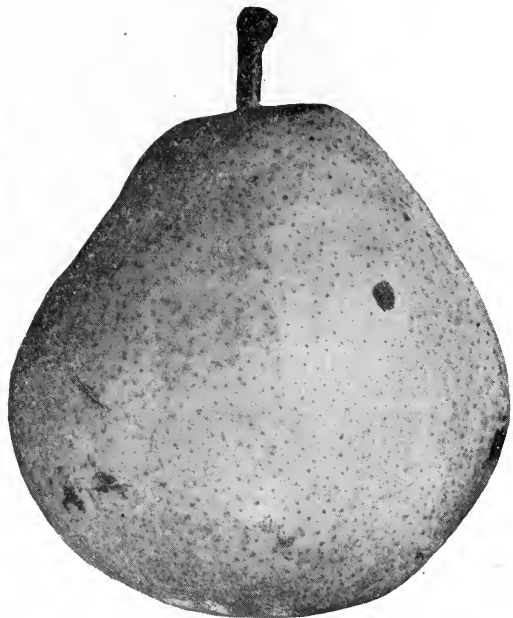


FIG. 7. Angouleme.

dwarfed on quince roots. In California it is little grown at the present time, but is a variety that can be recommended for small plantings. Its season lasts from early fall until about November.

**Anjou.**

The Anjou originated in France, as did many others of our popular varieties. Fruit is average sized to large. Skin very smooth and attractive, the common color being light yellow with green tinge, sometimes blush on one side. Shape obtuse pyriform. Open calyx set in a very small, shallow regular basin. Stem short, about  $\frac{3}{4}$  of an inch. Cavity small. Surface of the fruit is covered with small brown dots. Quality very good, being quite fine grained, juicy and good flavored. Strongly aromatic.

Trees of this variety attain a large size. They are subject to blight but otherwise hardy. Under certain conditions the Anjou is rated as a shy bearer. At the present time it is little grown in the state but is very promising for the higher elevations at least, where it has done



FIG. 8. Leaf of Anjou.



FIG. 9. Anjou.

well in limited plantings. It is a variety that keeps well into the winter, under favorable storage conditions. In 1916 some fine specimens were purchased in San Francisco on December 28, when they were firm and in splendid condition for table use. Its season is generally earlier than this date, and most of the fruit is gone by December 1.

#### **Bartlett.**

As already stated, this is by far the most common variety grown in California, and probably between 80 and 90 per cent of all pear trees in the state are Bartletts. The Santa Clara Valley furnishes the one notable exception of a section where many other kinds are grown in a commercial way. There also the Bartlett is popular and could not be considered inferior to any of the other varieties that are found in that section. It is justly popular for a number of reasons, important of which are its early, regular and heavy-bearing tendencies, very good quality, unequalled drying and canning characteristics, good shipping qualities and wonderful adaptability to the varying soil and climatic conditions of the state. Its chief drawback is its susceptibility to pear blight. While there are other varieties that are more susceptible, Bartlett blights very readily and in sections where this disease is prevalent trees are almost sure to

contract it. The Bartlett originated in England, where it was named William's Bon Chretien and where it is still known by that name. Downing, in his "Fruit Trees of America" states: "When first introduced to this country its name was lost and, having been cultivated and disseminated by Enoch Bartlett, Esquire, of Dorchester near Boston, it became so universally known as the Bartlett pear that it is impossible to dispossess it now."

The fruit is large, attaining on an average  $2\frac{1}{2}$  inches at the time of picking. The color is light yellow, with a beautiful red blush when grown under conditions favorable to coloring. The mountain counties of the state favor the coloring of Bartletts and many beautiful specimens are grown in higher altitudes as in the pear-growing sections of Lake, Nevada, Placer and El Dorado counties. Ordinarily, Bartlett has a clear, smooth skin but when grown under certain conditions it is

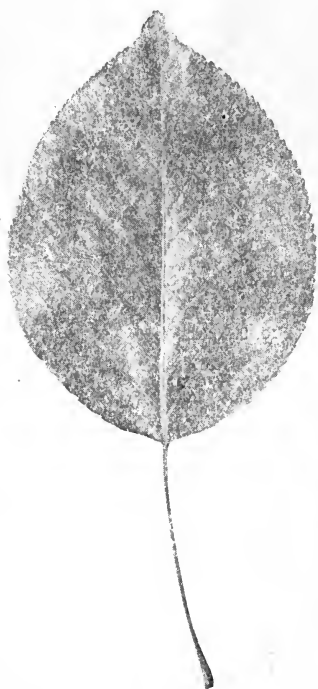


FIG. 10. Leaf of Bartlett.



FIG. 11. Bartlett

sometimes irregular and roughened. In sections of high wind and extremes of temperature it becomes misshapen. The quality of such fruit may be fine and may compare very well with that grown under the most favorable conditions. In shape it is obtuse pyriform. Calyx open or partly closed. Basin shallow and slightly irregular. Stem quite heavy; average length about 1 inch. Cavity small and regular. Few pears possess a finer texture or better quality. It is sweet, juicy.

aromatic and buttery. Ripening takes place with little or no shrinking, even when picked to all appearances green. The possession of all these characteristics makes the Bartlett the leading pear of California.

The trees have an upright habit of growth and require careful pruning to outside buds and branches to develop a proper spread. As they get older and heavy loads of fruit are borne this habit is overcome to a large extent. The size attained by trees of the Bartlett variety is not as great as in the case of many others. In some of the mountain sections it is inclined to be rather small, due no doubt in many instances to shallow soil and lack of fertility or insufficient moisture, and in others to heavy production, especially while young. Other factors, such as root aphid, crown gall and blight, may be respon-

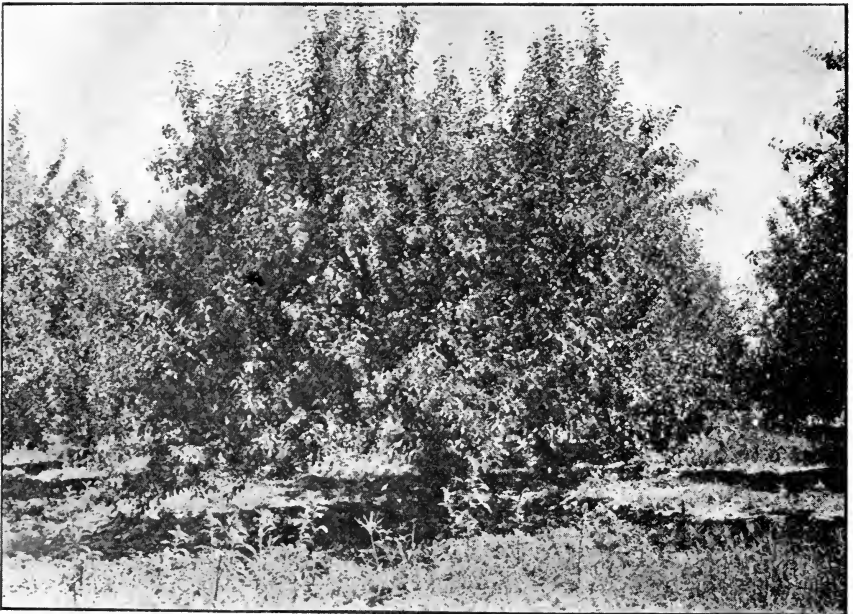


FIG. 12. Large Bartlett tree grown in fertile soil of the Sacramento River section of Sacramento County. This tree illustrates the result of plenty of room and furnishes an argument against planting trees too close together.

sible for the unusually small size of the trees in some sections. When not planted too close together in the orchard and if soil conditions are favorable they often attain a large size. Fig. 12 illustrates a case of a fine large tree due to a deep rich soil and plenty of room for the branches to spread. The branches are ordinarily stocky and strong, requiring very little or no propping when rightly pruned. Some very large, excellent specimens of trees may be seen on the rich alluvial soils along the Sacramento River. One tree observed was planted in 1854. It is still in prime condition and bears heavy crops of fruit regularly. More often, however, size is sacrificed for numbers of trees per acre, which in the early years of an orchard at least results in a bigger yield.

Blooming takes place in the valley sections of California shortly after the middle of March, the date varying with seasons. In 1915 the writer's notes show that on March 25 Bartletts were in full bloom on the Sacramento River at Hood and Courtland, and also in the Santa Clara Valley in the vicinity of San Jose. During the same season trees of this variety were in full bloom near Placerville, El Dorado County, on April 9.

Picking begins in the earlier sections about the last week of June or first week of July, continuing in these sections until the middle of August or later. The first pears picked are packed and shipped fresh to outside markets, while much of the later picked fruit is handled by the canneries. In the mountain counties where fruit is grown at an elevation of 1,500 feet or more, picking begins about the middle of August, lasting well into September. This is also true of the Palmdale and Lancaster sections of Los Angeles County and the Tehachapi section of Kern County, where despite desert conditions the fruit is late in maturing. This later picked fruit will keep in cold storage until December 1 or later, while the earlier picked valley Bartletts are practically all consumed by November 1.

#### Bloodgood (New York).

Tree short, jointed, deep reddish-brown wood. Fruit medium turbinate, inclining to obovate, thickening abruptly into stalk. Yellow, sprinkled with russet dots. Calyx strong, open almost without depression. Stalk obliquely inserted, without depression, short fleshy at its base. Flesh yellowish white, melting, sugary, aromatic, core small. (Description by Wickson.)\*

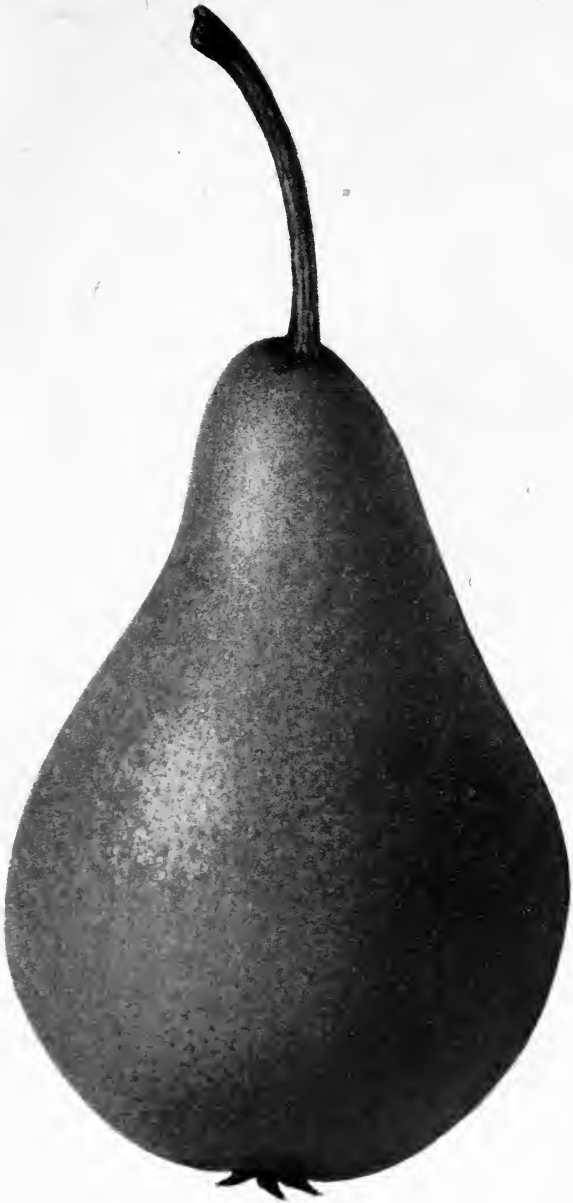
#### Bordeaux.

Origin France. Size large. Color light yellow with light blush. Skin covered with small brown dots. Shape irregular obtuse pyriform. Calyx open. Basin medium to large size and slightly corrugated. Stem  $1\frac{1}{2}$  inch long or more and very heavy. Cavity small and inconspicuous. Quality medium. Grown only experimentally in the state. Season very late.

#### Bosc.

Origin Belgium. Fruit large. Shape acute pyriform, very long and narrow. Skin yellow, somewhat rough and covered almost entirely with a heavy brown or cinnamon russet. Calyx open and set in a very shallow smooth basin. Stem averages about  $1\frac{1}{2}$  inches and is somewhat slender. Cavity small or absent. Quality best. Flesh white, very buttery, possessing a fine flavor, aromatic. At the present time the Bosc is not extensively grown in California. It does exceptionally well in the Santa Clara Valley and is considered by some of the leading pear growers to be one of the very best varieties for that section. In the Rogue River Valley of Oregon, just beyond the northern California boundary, it reaches its prime. The trees bear evenly, heavily and

\* "California Fruits," seventh edition.



BOSC





consistently. The variety is recommended for more general planting in the state. Its season is rather early, being off the market about



FIG. 13. Leaf of Bosc.



FIG. 14. Bosc.

November 1. There is no more beautiful sight in the way of pears than an orchard of this variety in full bearing. Blooms a few days later than Bartlett.

#### **Boussock.**

Origin Belgium. Size large. Color lemon yellow with russet spots. Shape obtuse pyriform. Calyx open. Basin shallow. Stem short and stout. Cavity small and narrow. Quality good. Grown only experimentally in California up to the present time. Season medium.

#### **Bretonneau.**

Origin Belgium. Size medium to large. Color greenish yellow with deep blush. Shape obovate pyriform. Calyx open. Basin medium size. Stem heavy, about 1 inch long. Cavity absent. Quality poor. Grown only experimentally and because of its poor quality it is not recommended for general use. Season late to very late.



FIG. 15. Leaf of Boussock.

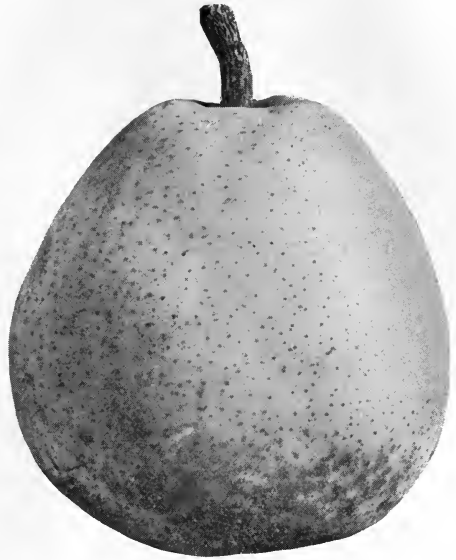


FIG. 16. Boussock.

#### Cardinal.

Size medium to large. Shape roundish pyriform. Color greenish yellow with inconspicuous brown dots and light russet. Calyx open or partly to wholly closed. Basin corrugated and fairly large. Stem very stout and about  $\frac{3}{4}$  inch long. Cavity inconspicuous. Quality very good. Season late December. A promising variety as grown by A. L. Wisker.

#### Clairgeau.

Origin France. Size large. Color yellow until ripe when a large portion is often a beautiful red, making the fruit very attractive. Skin rather rough and splashed with russet. Surface covered with conspicuous russet dots. Shape pyriform. Calyx open. Basin small and shallow. Stem short,  $\frac{5}{8}$  inch or less and heavy, with fleshy projection at base. Cavity absent. Quality medium to good. The texture is coarse and the flavor sweet and good. The sale of this variety is very largely dependent upon its looks. It is a good keeper but is best in fall or early winter. Little grown in California. Trees are large and thrifty. The leaf characteristics as shown in Fig. 19, while somewhat variable, make it easily identified. Note the characteristic short pointed apex, wide middle and very narrow base formed by abrupt angle. Prolific. Blooms early with Howell and Forelle.



FIG. 17. Leaf of Cardinal.



FIG. 18. Cardinal.

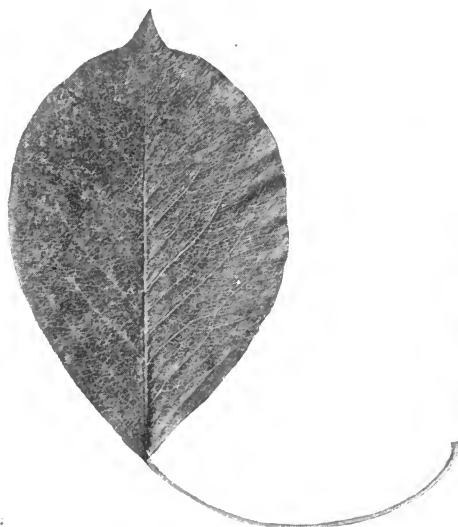


FIG. 19. Leaf of Clairgeau.

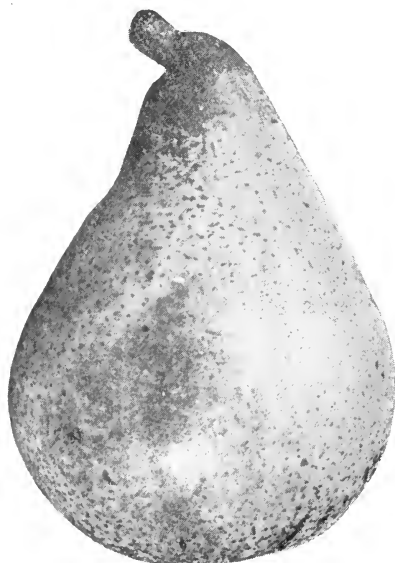


FIG. 20. Clairgeau.

**Clapp Favorite.**

Origin Massachusetts. Size large. Color pale yellow, slightly russet, and beautiful blush. Shape slightly obtuse pyriform. Surface somewhat uneven. Skin thickly sprinkled with brown dots. Calyx open or partially closed. Basin shallow and slightly roughened. Stem heavy, 1 inch long or less. Cavity small. Quality good. Flesh is fine grained, white, rich and sweet. Season medium early, last of July and August. Very little grown in California.



FIG. 21. Leaf of Clapp Favorite.



FIG. 22. Clapp Favorite.

**Comice.**

Origin France. Fruit large. Color green or light yellow with more or less russet, sometimes blushed with dull red. Surface sprinkled with light brown or dark green dots. Shape obtuse pyriform, truncate. Calyx closed in most California specimens examined, though sometimes partially or wholly open. Basin very large, deep, rough and abrupt. Stem short, heavy, about  $\frac{3}{4}$  inch. Cavity well defined but shallow. Quality very good to best. Flesh medium to fine grained, juicy, sweet, slightly aromatic. Season late fall. Grown locally in California. A good variety, especially under Santa Clara Valley conditions.



FIG. 23. Leaf of Comice.

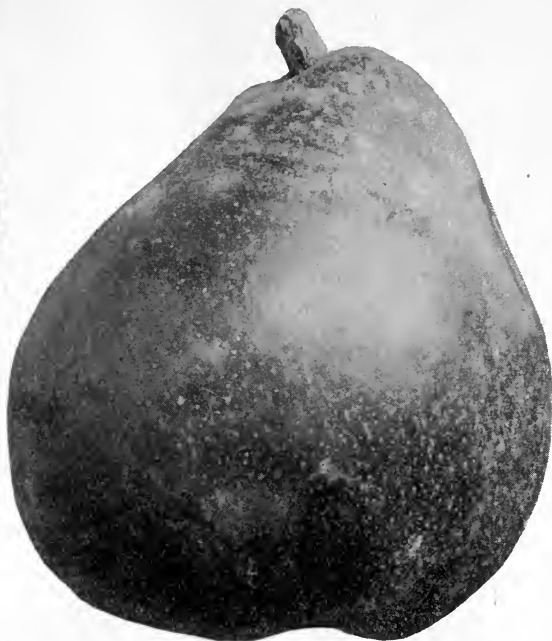


FIG. 24. Comice.

**Cook (A. J.).**

New variety. Shortly after coming to California in June, 1913, the writer's attention was called to a graft from a chance seedling pear tree growing in the orchard of County Horticultural Commissioner J. E. Hassler of Placerville. From Mr. Hassler's description of the fruit, it was thought that the variety might be worth propagating. During each season since that time specimens of the pears have been received, through the kindness of Mr. Hassler, and the tree with its load of fruit has been seen. The quality being good and other characteristics desirable, the variety, which at present is being propagated by A. L. Wisker of Grass Valley, is recommended for trial in the different pear-growing sections of the state. In the foothill region of the Sierras, judging from the hardiness and steady, heavy bearing characteristics of the tree, it is a promising variety for early winter use. In cold storage it will keep for the holiday season.

**ORIGIN.**

The variety originated on a place adjoining the Hassler ranch. The original tree is still standing and on October 19 of last year it was observed by the writer. It is growing on low, wet land, close to a little stream, among willows and other brush. The leaves are very small and the branches scraggy because of the unfavorable conditions.

Each season it bears some fruit. Scions were taken from this tree by Mr. Hassler about thirteen years ago, and grafted into a Bartlett in the orchard. The grafted tree, therefore, has been growing under identical conditions that surround the other trees in his orchard.

#### HABITS OF GROWTH.

In habits of growth, color of wood and general appearance this tree resembles Bartlett very closely and at a distance of a few yards it would be mistaken for this variety. A closer examination shows that the branches are more slender and whiplike and inclined to be crooked like Winter Nelis. Though younger than the Bartlett trees, the A. J. Cook is much larger than the average sized Bartlett in the orchard. The leaf characteristics are quite different, as may be seen by comparing the leaf in Fig. 10 with that in Fig. 28.

#### BLOOMING CHARACTERISTICS.

One thing that commends it strongly for sections of higher elevations is its delayed blooming habit, which will enable it to escape injury from late frosts that might ruin the Bartlett crop. Fig. 25 is from a picture

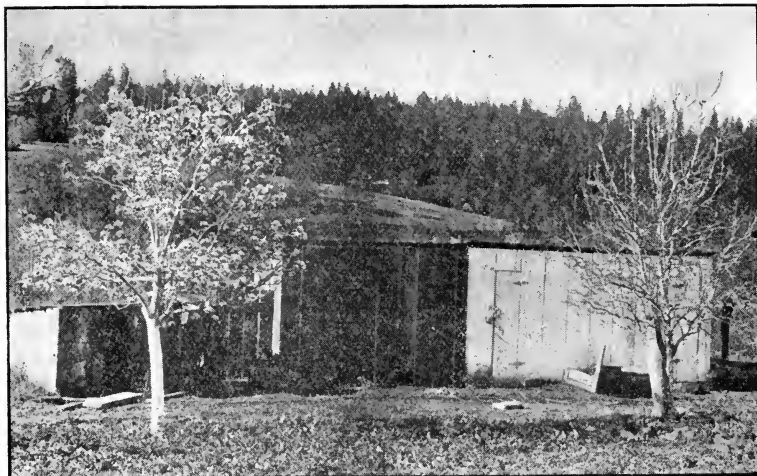


FIG. 25. Bartlett tree on left, A. J. Cook (new variety) on right, illustrating the late blooming habit of the latter variety.

taken on April 9, 1915. The tree on the left is a Bartlett which at the time was in full bloom. It will be noticed that the A. J. Cook has not begun to show any blossom. The blooming time is from ten days to two weeks later than that of the Bartlett.

#### BEARING HABITS.

Mr. Hassler states that the tree has been a regular and consistent bearer, averaging fully as good, if not better than Bartletts growing under the same conditions in the same orchard. In 1916, it produced



FIG. 26. Heavy load of fruit on A. J. Cook (new variety) in 1916.  
Photo by J. E. Hassler.

approximately 400 pounds of fruit and again in 1917 about the same amount. Fig. 26 shows the large crop of 1916. The heavily laden branches had to be propped and testify to the fruitfulness of the variety.

#### NAME.

The name A. J. Cook was given to this new pear by Mr. A. L. Wisker at the suggestion of Mr. Hassler, a firm friend of the late State Commissioner of Horticulture, who frequently visited the beautiful Hassler ranch, and who took a keen interest in the horticultural development of the place. Mr. Wisker was the first man to propagate this variety, and in fact as far as the writer is aware, is the only one in California at the present time who has the trees growing in his nursery. The description was published in a price list of the Loma Rica Nurseries in 1916.

#### DESCRIPTION OF FRUIT.

Size medium to large; surface somewhat warty or irregular. Color yellow like Bartlett, often with beautiful red blush. Skin smooth and shiny, with little russet. Shape obtuse, pyriform, variable. Some specimens are shaped almost exactly like Bartlett, others resemble Winter Nelis. There is a characteristic fleshy projection, frequently covering the cavity, the stem being attached at right angles as in Fig. 30.

The Winter Nelis and Bartlett types are shown respectively in Figs. 29 & 31. Calyx, like Bartlett, usually open but sometimes nearly closed. Basin small to medium sized and shallow, more or less corrugated. Stem short,  $\frac{1}{2}$  inch to inch. Cavity irregular, frequently entirely eliminated by fleshy projection. Quality medium to good. The texture is rather coarse, but the flavor sweet and pleasant. Apparently somewhat subject to core rot.



FIG. 27. View of A. J. Cook (new variety), illustrating the Bartlett characteristics of growth.

#### Dana's Hovey.

Origin Massachusetts. Size small to medium. Color pale yellow, considerable russet. Shape obtuse pyriform, regular. Skin smooth and covered with conspicuous gray dots. Calyx open. Basin wide, shallow, sometimes inconspicuous. Stem heavy, 1 inch or less in length. Cavity slight, abrupt. Quality very good to best, juicy, sweet, melting, aromatic. Season October to January.

Downing places this pear in a class with Seckel in regard to its quality. It does well in the foothills of the Sierras of California. Some very select fruit has been seen from Nevada County. Its small size is against its commercial use on a large scale. It is a splendid variety for small home plantings.





FIG. 28. Leaf of A. J. Cook (new variety).

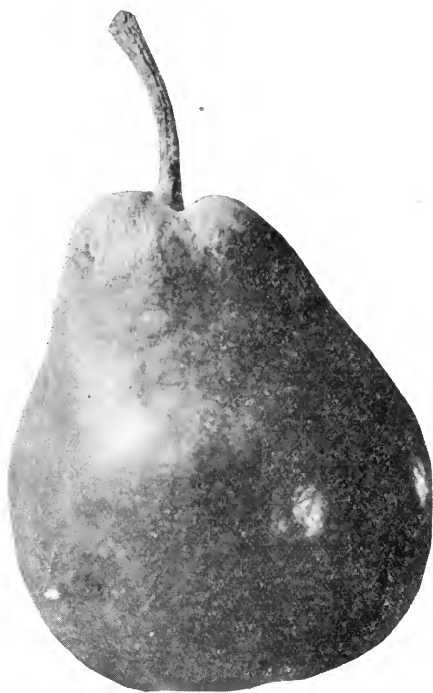


FIG. 29. A. J. Cook (new variety), shaped somewhat like Winter Nellis.



FIG. 30. A. J. Cook (new variety), showing a common type with stem emanating at right angles.

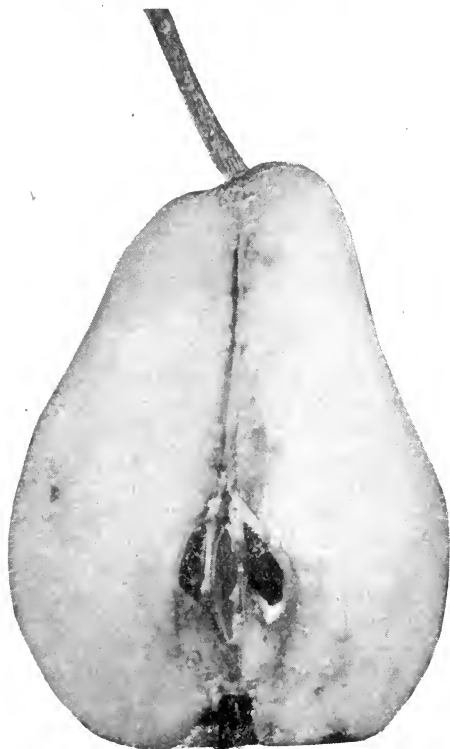


FIG. 31. A. J. Cook (new variety), cut in half to show calyx and core characters.

**Dearborn's Seedling** (Massachusetts).

Young shoots long, reddish brown; fruit under medium size. Roundish pyriform. Skin smooth, clear light yellow, with few minute dots. Stalk slender, set with very little depression. Calyx spreading in shallow basin. Flesh white, very juicy, melting, sprightly. (Description by Wickson.)\*



FIG. 32. Leaf of Dana's Hovey.



FIG. 33. Dana's Hovey.

**Diel.**

Origin Belgium. Size large. Color yellow with slight russet. Skin covered with medium sized russet dots which are very abundant. Shape obtuse pyriform. Calyx closed. Basin small, somewhat corrugated and irregular. Stem heavy, about 1 inch long. Cavity rather uneven. Quality medium. Little grown in California. Season September to November or later.

**Dix.**

The original tree stands in the garden of Madam Dix, Boston. It bore for the first time in 1826. The Dix is one of the hardiest of pear trees, but the tree does not come into bearing until it has attained considerable size. The young branches are dull olive yellow brown, upright and slender. Fruit large, oblong, or long pyriform. Skin roughish, fine deep yellow at maturity, marked with distinct russet dots, and sprinkled with russet around the stalk. Calyx small for so large a fruit. Basin narrow, and scarcely at all sunk. Stalk rather stout, short, thicker at each end, set rather obliquely, but with little or no depression. Flesh not very fine grained, but juicy, rich, sugary,

\* "California Fruits," seventh edition.



FIG. 34. Leaf of Diel.



FIG. 35. Diel.



FIG. 36. Leaf of Dix.



FIG. 37. Dix.

melting and delicious, with a slight perfume. Very good to best.\* From what is known of this variety in California it can not be rated higher than medium quality. Season October and November.

#### Easter Beurre.

Origin Belgium. Size large. Color green or unevenly colored lemon yellow; brown russet. Surface covered with light green or brown dots which are very conspicuous until fruit colors, when they become inconspicuous or obsolete. Shape roundish obovate. Calyx closed. Basin wide and shallow, very irregular and corrugated. Stem short and



FIG. 38. Leaf of Easter Beurre.



FIG. 39. Easter Beurre.

heavy. Cavity well defined, abrupt. Quality medium to good. Highly esteemed for baking. It is rather coarse and does not compare favorably with Winter Nelis, which is in season at the same time or up to January 1 or later. The trees of this variety attain a great size. Some orchardists have grafted them over to Bartlett. A splendid union results from such grafts.

#### Flemish.

Origin Belgium. Size large. Color yellow with blush like Bartlett, slight russet. Shape obtuse pyriform. Calyx open. Basin small and round. Stem 1 to 1½ inches long. Cavity well defined, round and very

\*From Downing's "Fruits and Fruit Trees of America."

narrow. Quality good. Rather coarse grained. Flesh yellow, juicy and sweet. Season early, September and October. A fairly good early fall variety but little grown in the state.



FIG. 40. Leaf of Flemish.



FIG. 41. Flemish.

#### Forelle.

Origin Germany. Size medium to large. Color, light yellow with beautiful red cheeks. Surface covered with large, very conspicuous brownish dots, giving it a speckled appearance, from which it derives its name of "trout" pear. Shape variable, sometimes very long oval pyriform, at other times obovate obtuse pyriform. Calyx open. Basin small, rather abrupt and regular. Stem short and somewhat slender. Cavity uneven, practically absent. Quality medium to good.

This variety is grown commercially only in the Santa Clara Valley of California. The trees do well under the conditions of that section. The appearance is very characteristic owing to the fact that the foliage resembles that of the apple. The wood is reddish brown in color similar to that of the Rome Beauty apple. The extreme beauty of well-grown fruit has a tendency to overcome objectionable features and enhance its sale in the markets. It blooms early and is in season about

October to January. According to Reimer<sup>1</sup> the Forelle is more subject to blight than any other variety with which he has experimented.



FIG. 42. Leaf of Forelle.



FIG. 43. Forelle.

#### Gaillard.

Size medium to large. Color yellow. Skin very smooth with light russet. Shape obtuse pyriform. Calyx open. Basin russeted, narrow, deep, regular. Stem short and heavy,  $\frac{3}{4}$  inch or less, obliquely inserted in lipped cavity. Quality medium to good. Flesh somewhat coarse, juicy, sweet; lacks richness and fragrance. Ripe at Grass Valley early in November. Mr. Wisker, who aided in the description of this pear, states that "it is almost an exact duplicate of Anjou, except that the basin is deep, whereas in Anjou it is very shallow." He reports it to be wonderfully productive in his orchard at Grass Valley but does not recommend its general use as there are other better pears that ripen about the same time.

#### Giffard.

Origin France. Fruit medium size, pyriform, tapering to the stem, which is rather long; skin greenish yellow, marbled with red on exposed side. Calyx closed. Flesh white, melting, juicy, vinous flavor. Very good. Ripens in August. Should be gathered before fully ripe. (Description by Brackett.)<sup>2</sup> Rated only medium quality in California. Ripens with Lawson, which it much excels in quality.

<sup>1</sup> "Pear Blight Resistance in Trees and Stocks." Address before the Pacific Coast Association of Nurserymen at Medford, Oregon.

<sup>2</sup> "The Pear and How to Grow It." Farmers Bulletin 482, U. S. Department of Agriculture.



FIG. 44. Leaf of Gaillard.

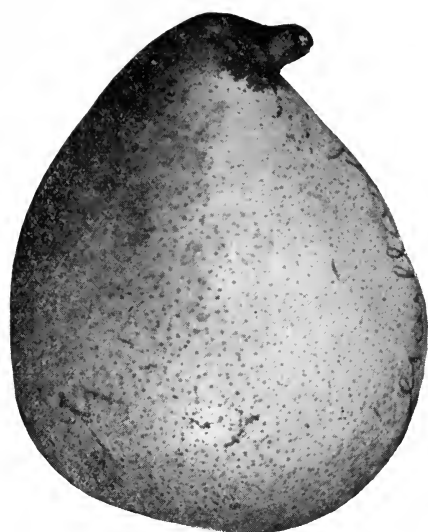


FIG. 45. Gaillard.



FIG. 46. Leaf of Glout Morceau.



FIG. 47. Glout Morceau.

**Glout Morceau.**

Origin Belgium. Size large. Color green or light yellow. Skin smooth with small green dots. Shape ovate, obtuse pyriform, not unlike Keiffer. Calyx open. Basin deep and roughened. Stem medium, 1 inch or more. Cavity regular, small and abrupt. Quality medium. A popular variety in the Santa Clara Valley, where it has been grown for years. The season is early winter (November-December). Trees are very vigorous, spreading and fairly productive.



FIG. 48. Glout Morceau pear tree in a Santa Clara Valley orchard, showing the vigorous spreading type of growth.

**Hardy (Beurre Hardy).**

Origin France. Size large. Color green or yellow, covered with light brown russet. Shape oblong or obtuse pyriform. Calyx open. Basin smooth, wide and regular. Stem short and heavy, 1 inch or less. Cavity small or absent. Stem inserted on one side. Quality good to very good. Texture fine. Taste sweet, pleasant; very juicy and aromatic. This variety is in season a little after Bartlett. The trees are very large and bear heavily. They are less susceptible to blight than Bartlett. The latter variety does well when topworked on Hardy stock. It is a somewhat common variety in the state but there are no large plantings and in many cases this variety has been worked over to Bartlett, which is generally considered to be a better variety. Hardy is a good shipping pear, being popular for export on account of its fine carrying and eating qualities, and for local consumption it also has a valuable place in the orchard.





FIG. 49. Leaf of Hardy.



FIG. 50. Hardy.

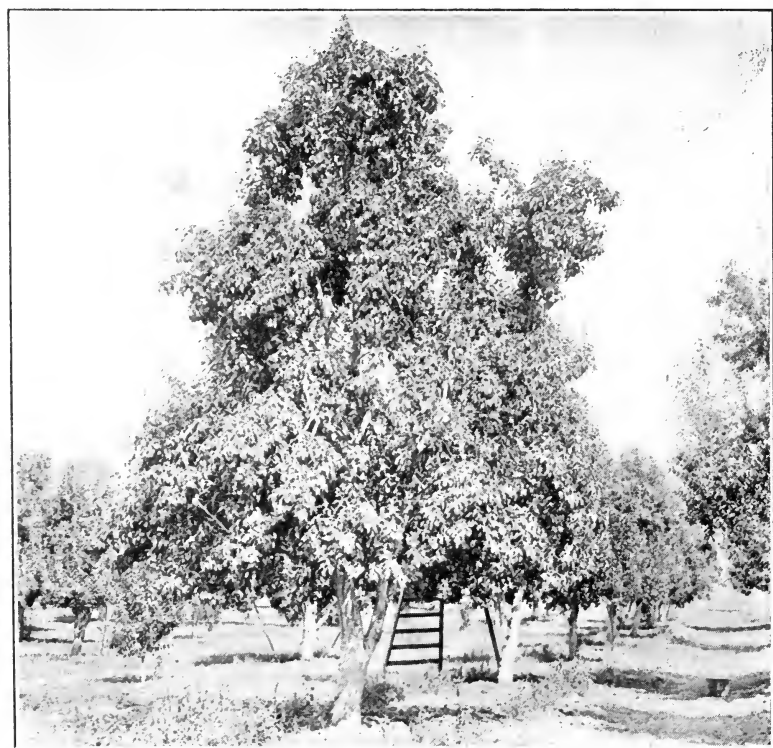


FIG. 51. Large Hardy tree, illustrating the characteristics of growth.

**Hassler** (new variety).

Origin Placerville, California. Size large. Color greenish yellow with russet dots. Skin very smooth and fine, a perfect-looking pear. Shape obtuse pyriform. Calyx open. Basin large, deep, irregular. Stem heavy, medium length or short. Cavity quite deep, with stem inserted at angle on one side. Texture, fine grained. Quality very good. Juicy, very buttery, sweet, pleasant. Season very late. Ripe February 23.



FIG. 52. Leaf of Hassler (new variety).

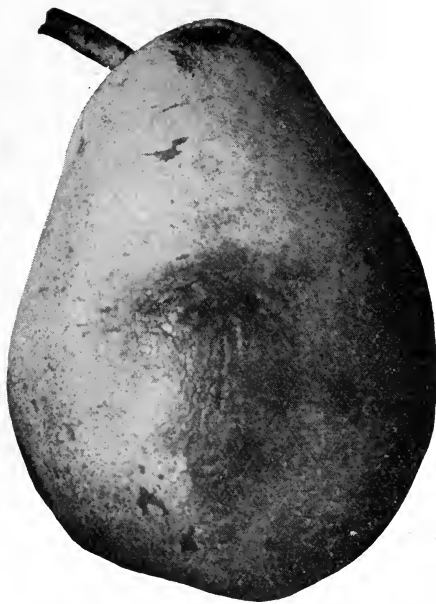


FIG. 53. Hassler (new variety).

Like the A. J. Cook, this variety originated as a chance seedling on the place of J. E. Hassler at Placerville. Some grafts were inserted into a Rossney tree in the orchard and this year for the first time bore a few fruits, most of which Mr. Hassler picked too early for proper ripening. On February 23, 1918, the writer received a fine sample of this pear in prime condition. Nothing can be said as yet about its bearing characteristics. Its apparently very good quality and extremely late ripening make it promising for late winter or early spring use.

**Heyst.**

Origin France. Size medium to large. Color yellow with considerable russet. Shape oblong, obovate, pyriform. Dots gray, inconspicuous and abundant. Calyx closed. Basin small, irregular, variable. Stem heavy, about  $1\frac{1}{4}$  inches long. Cavity small. Quality medium. Little grown in state. Season late.



FIG. 54. Leaf of Heyst.



FIG. 55. Heyst.

**Howell.**

Origin Connecticut. Fruit medium to large, very smooth, glossy, symmetrical and beautiful. Color green or light yellow. Surface covered with green, rather inconspicuous dots. Shape roundish, pyriform. Calyx open or partly closed. Basin corrugated, wide and fairly deep. Stem  $1\frac{1}{4}$  inches or over. Cavity absent, in most cases giving way to a more or less wrinkled fleshy condition at base of stem. Quality good to very good. Flesh whitish, fine grained, juicy and

buttery. Season September to November 1. It is prolific, blooms early and blights badly. Grown most at present in the Santa Clara Valley, where it has done well.



FIG. 56. Leaf of Howell.



FIG. 57. Howell.

**Idaho.**

Origin Idaho. Size large. Color yellow with russet dots. Shape globular like apple. Surface rough. Calyx closed. Basin deep, slightly corrugated. Stem short, about  $\frac{3}{4}$  inch. Cavity narrow, rather deep. Quality medium to good. Little grown in the state.



FIG. 58. Leaf of Idaho.



FIG. 59. Idaho.

**Joan of Arc.**

Origin France. Size medium to large. Color lemon yellow with thinly netted russet which becomes heavy at calyx. Skin smooth and regular. Shape oblong pyriform to obtuse pyriform. Calyx closed. Basin broad, deep, regular. Stem short and heavy, about  $\frac{3}{4}$  inch, obliquely inserted in fairly deep regular cavity. Quality very good. Flesh medium fine grained, melting, juicy; flavor rich, sweet, musky,

between Bartlett and Dana's Hovey. Ripe November 18. (Description by A. L. Wisker.) This variety is very promising and is recommended for trial in the different pear-growing districts of the state.



FIG. 60. Leaf of Joan of Arc.



FIG. 61. Joan of Arc.

#### Kieffer.

Origin Pennsylvania. A chance seedling, undoubtedly a cross between the Bartlett and the Chinese Sand Pear. Size medium to large. Color yellow, often with deep blush. Surface rather rough and covered with brown dots. Shape ovate pyriform, angular. Tapers abruptly and similarly toward stem and calyx. Calyx open or partly closed. Basin narrow and slightly corrugated. Stem strong and about 1 inch in length. Cavity abrupt and rather shallow. The Kieffer is not grown extensively in California. Quality poor. It is very coarse grained, being suitable mostly for canning purposes. In the south and parts of the east it is a popular variety because of its splendid adaptation to the conditions that exist where it is grown. The trees are large and thrifty. They are much more resistant to blight than the Bartlett but under certain conditions contract the disease readily. Because of their resistance to this disease, the use of trees

for top working to Bartlett was at one time recommended. The evidence points toward a satisfactory union and a tree with a Kieffer trunk and Bartlett top would possess at least a slight advantage in relation to blight resistance over a tree entirely Bartlett. It ripens late and is in season during the early winter months (November-December).

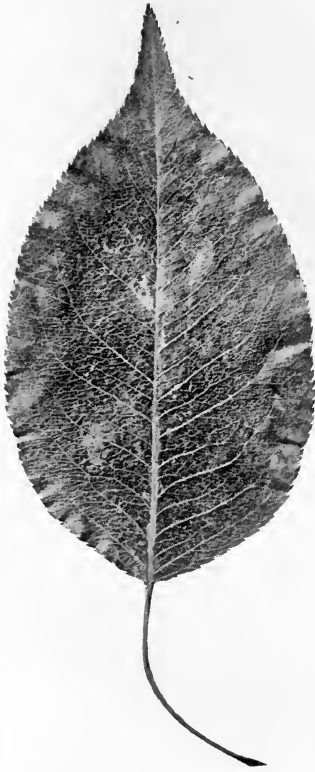


FIG. 62. Leaf of Kieffer.



FIG. 63. Kieffer.

#### Lawrence.

Origin New York. Size small to medium. Color lemon yellow splashed with russet and covered with numerous green dots. Shape obovate pyriform. Calyx open or partly closed. Basin wide and shallow, uneven. Stem medium size  $\frac{1}{8}$  inch long. Cavity well defined, irregular, russeted. Quality good to very good. Flesh whitish, juicy, buttery and sweet. Season about November and December.

One of the best small varieties. Recommended for limited planting only.



FIG. 64. Leaf of Lawrence.

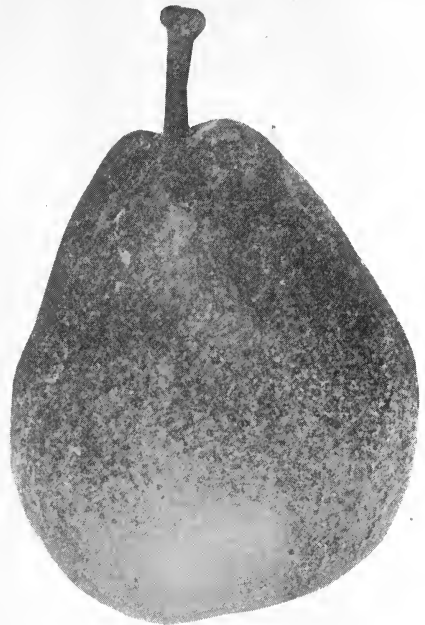


FIG. 65. Lawrence.

#### Lawson (Comet).

Origin New York. Size medium to large. Color light yellow often blushed with crimson. Skin smooth and covered with large, green, conspicuous dots. Shape obtuse pyriform. Calyx open or closed. Basin obtuse, shallow. Stem short,  $\frac{3}{4}$  inch to  $1\frac{1}{4}$  inch, inserted obliquely and emanating from a fleshy projection. Cavity absent. Quality poor to medium.

This variety does well along the Sacramento River, where it is the first pear to be shipped during the season. Its extreme earliness makes it popular for limited plantings to supply the early market. The writer picked some specimens from an orchard near Courtland, on July 12 last season. They were overripe, mealy, lacking in juice and scarcely fit to eat, and all pears of this variety that were left were simply the few overlooked in picking, or which were too small at the time of picking.

#### Le Conte.

Origin New York. Size medium. Color yellow, with blush. Skin rough with abundant large, deep green dots. Shape angular oval pyriform, resembles Kieffer. Calyx closed or partly open. Basin small, smooth. Stem  $1\frac{1}{4}$  inch or less, heavy. Cavity small. Quality poor, like Kieffer. This variety is little grown in the state, and like Kieffer is not recommended for sections where first-class varieties do well.



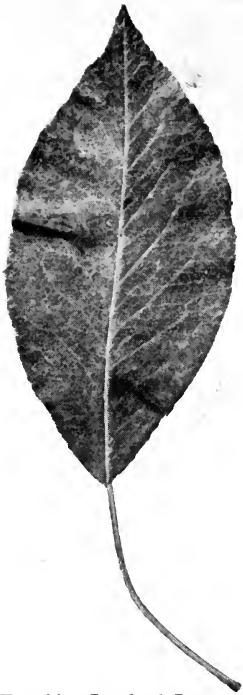


FIG. 66. Leaf of Lawson.



FIG. 67. Lawson.



FIG. 68. Leaf of Le Conte.



FIG. 69. Le Conte.

**Le Lectier.**

Origin France. Size medium. Color yellow, slight russet. Dots green, inconspicuous. Shape oblong pyriform. Calyx closed. Basin small, rather wide, corrugated. Stem fleshy, 1 inch to  $1\frac{1}{4}$  inch. Cavity absent. Quality good. Grown only experimentally. Season medium.

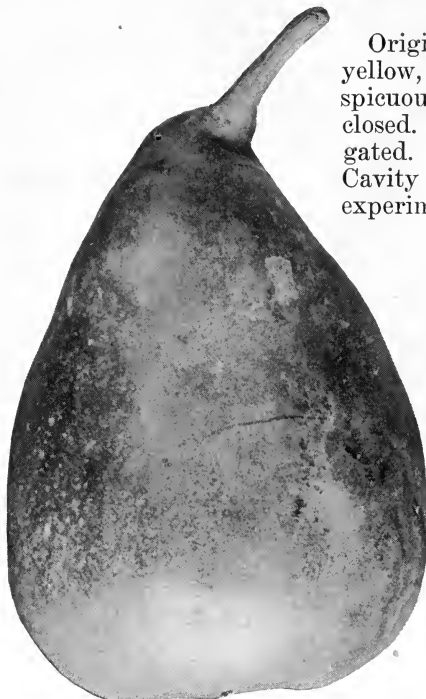


FIG. 70. Le Lectier.

**Louise (Louise Bonne de Jersey).**

Size large. Color green. The surface of the skin is covered abundantly with conspicuous large deep green dots. Shape oblong pyriform. Calyx open. Basin small, shallow and corrugated. Stem light, 1 inch to  $1\frac{1}{4}$  inch long, inserted obliquely. Cavity absent. Quality good. An early fall variety little grown in the state. Some good specimens have been seen in the Santa Clara Valley. The trees are large and said to be productive. It is claimed that this variety is better when grown as a dwarf than when on standard stock.



FIG. 71. Leaf of Louise.

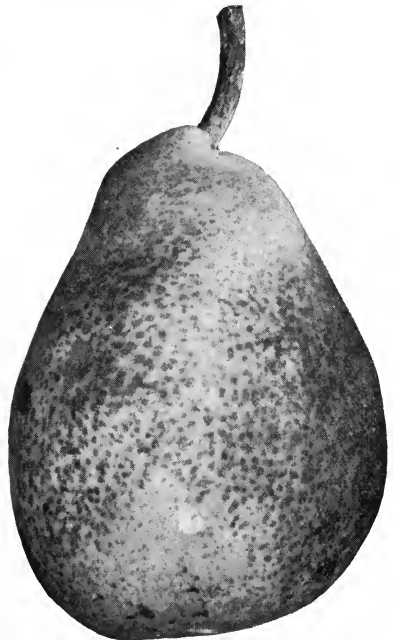


FIG. 72. Louise.

**Lucrative** (Belle Lucrative).

Origin Flemish. Medium size, variable in form from globular to obtuse pyriform. Stalk  $1\frac{1}{4}$  inch long, often fleshy, oblique. Cavity small and narrow. Calyx short, open. Flesh juicy, melting, rich, sugary, delicious. Season last of September. (Description by Brackett.)\* Quality medium in California.

**Madeleine Early** (French).

Small, obovate pyriform, stalk long and slender, set on the side of a small swelling pale yellowish green, rarely brownish blush; calyx small, in shallow furrowed basin; flesh white, juicy, delicate. (Description by Wickson.)\* Quality good in California.

**Marguerite Marillat.**

Size very large. Color yellow, blushed. Stem short, stout, usually inserted almost at a right angle. This trait is apparently a character-



FIG. 73. Marguerite Marillat.

istic of the variety. Flesh fine grained, buttery, melting, rich, juicy, sweet, somewhat like Bartlett, which it equals in quality. Ripe September 20. (Description by A. L. Wisker.)

\* "The Pear and How to Grow It." Farmers' Bulletin 482, U. S. Department of Agriculture.

\*\* "California Fruits," seventh edition.

**Mount Vernon.**

Origin Massachusetts. Size small. Color green or light yellow with russet. Shape round, obtuse. Skin shows many green but very inconspicuous dots. Calyx open. Basin quite wide and shallow. Stem short, about  $\frac{3}{8}$  inch to slightly more, inserted on one side. Cavity small. Quality good to very good. From what little is known of this variety in California one would be led to recommend its planting experimentally at least. In season in early winter.



FIG. 74. Leaf of Mount Vernon.



FIG. 75. Mount Vernon.

**Onondaga (Connecticut).**

Large, obtuse, oval pyriform, neck very short and obtuse, body large and tapering to obtuse apex. Flesh melting, sprightly, vinous. A vigorous, upright grower, healthy; yellow shoots; sells well in distant markets. (Description by Wickson.)\* Apparently of no value in California.

**P. Barry.**

Origin California. Size large. Color green heavily covered with russet. Skin is rough and conspicuously marked with large brown dots. Shape ovate pyriform. Calyx open. Basin very small, practically absent. Stem about 1 inch long, heavy. Cavity small. Quality medium. The greatest objection to this variety is its susceptibility to blight. It is grown to a small extent in the Santa Clara Valley, where it was originated by B. S. Fox, and in the foothills of the Sierras. Keeping qualities are good. In season about November and December, or later from storage.

\* "California Fruits," seventh edition.

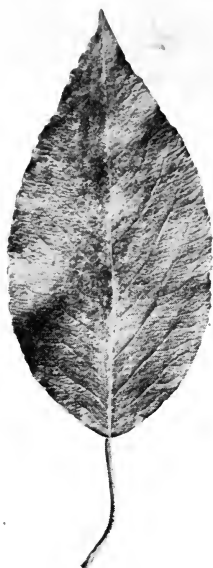


FIG. 76. Leaf of Onondaga.

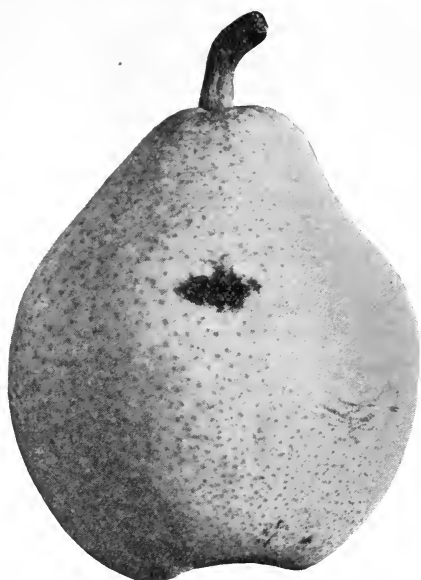


FIG. 77. Onondaga.



FIG. 78. Leaf of P. Barry.



FIG. 79. P. Barry.

**Philopena.**

Origin Indiana. Size small to medium. Color yellow with purple blush. Shape oblong pyriform. Calyx open. Basin small, shallow. Stem short. Cavity small or absent. Quality medium. Season about three or four weeks after Bartlett.

**Pound.**

Origin unknown. Size very large. Color yellow with considerable russet. Skin covered with an abundance of small variable green dots. Shape pyriform, tapering gradually to a point at the base of stalk. Calyx closed. Basin small, irregular, very corrugated. Stem heavy, about  $1\frac{1}{2}$  inch long. Quality poor. The trees are large and vigorous, the fruit being grown mostly for its size. Fairly good for cooking. Specimens bought in San Francisco on December 27, 1916, were non-edible. They were selling at that time for from 75 cents to \$1.25 per box.

**Rossney.**

Origin Utah. Size large. Color yellow with red blush. Shape obovate pyriform, tapers quickly to narrow point. Calyx open. Basin small. Stem heavy, medium length. Cavity small or absent. Quality good to very good. This variety is little grown in the state. It is said by Mr. J. E. Hassler of Placerville to be an excellent variety for drying under the conditions existing in El Dorado County.



FIG. 80. Leaf of Rossney.



FIG. 81. Rossney.

**Seckel.**

Origin Pennsylvania. Size small. Color reddish brown with russet and red cheek. Shape obovate. Calyx open. Basin small and shallow. Stem short and heavy, about  $\frac{5}{8}$  inch. Cavity small. Quality best. Flesh fine grained, sweet and buttery. Downing in his "Fruits and Fruit Trees of America" states: "We do not hesitate to pronounce this American pear the richest and most exquisitely flavored variety known. In its highly concentrated, spicy and honeyed flavor it is not surpassed, nor indeed equaled, by any European variety." When shipped from Sacramento Valley usually sells well—\$1.75 to \$2.00 per  $\frac{1}{2}$  box (25 pounds).

The tree is very hardy and a heavy bearer of clustered fruits. It is not grown in large commercial plantings in this state because of its small size, and early ripening characteristics. It is an early fall pear and every orchardist should have at least one tree in his home orchard.



FIG. 82. Leaf of Seckel.

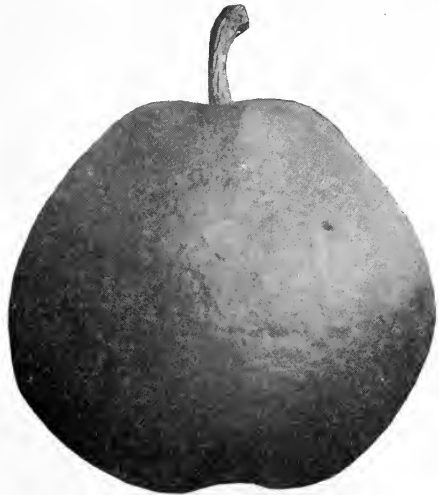


FIG. 83. Seckel.

**Sheldon.**

Origin New York. Medium or large, roundish, obtuse obovate; skin greenish yellow, covered with thin russet, a little brownish crimson with russet dots on exposed side; stalk short, stout; cavity deep; calyx open. Flesh whitish, sweet, very juicy, melting, vinous, texture rather coarse; very good; October. Tree vigorous; it requires double working on quince. (Description by Brackett.)<sup>1</sup>

<sup>1</sup> "The Pear and How to Grow It." Farmers' Bulletin 482. U. S. Department of Agriculture.

**Souvenir.**

Origin France. Size large. Color handsome yellow with red blush. Skin covered with light green dots with yellow center. Shape, obtuse pyriform. Calyx closed. Basin deep and irregular. Stem short, heavy,  $\frac{5}{8}$  inch more or less. Cavity small. Quality poor. Season medium early.



FIG. 84. Leaf of Souvenir.



FIG. 85. Souvenir.

**Superfin.**

Origin France. Size medium. Color yellow with cinnamon russet. Shape round pyriform. Texture, juicy, buttery, melting. Flavor vinous, subacid. Quality good to very good. Season medium. (Description by Ragah.)<sup>2</sup>



FIG. 86. Superfin.

**Touraine.**

Size medium. Color greenish yellow, no blush. Shape oblong pyriform. Calyx partly closed. Basin medium. Stem long,  $1\frac{1}{4}$  inch or more, emanates from one side. Cavity small. Quality medium. Season late.

<sup>2</sup> "Nomenclature of the Pear." Bulletin 126, Bureau of Plant Industry.



**Tyson.**

Origin, Pennsylvania. Medium or below in size. Conic pyriform. Skin clear deep yellow, with a fine crimson cheek and numerous brown dots. Stem long and curved, inserted with a fleshy ring or lip. Calyx closed. Flesh juicy, very sweet, melting, aromatic. Late summer. Tree vigorous, upright grower, very productive. An excellent variety both in tree and fruit. (Description by Brackett.)<sup>1</sup> Rated as medium quality in California.

**Urbaniste.**

Origin Belgium. Size medium to large. Color yellow, russet. Shape obovate pyriform. Texture buttery, melting, juicy. Flavor perfumed. Quality very good to best. Season medium late. (Description by Ragan.)<sup>2</sup> Rated as medium quality in California.

**Vanille.**

Size small. Color yellow with beautiful blush which covers more than half of the pear. Shape roundish, obtuse obovate. Calyx deciduous. Basin wide and quite large. Stem  $\frac{3}{4}$  inch long or less. Cavity very small. Quality medium. Season late.

**Vicar (Vicar of Wakefield).**

Origin France. Size large. Color green or light yellow when thoroughly ripe; very light red blush. Skin smooth, covered with an



FIG. 87. Leaf of Vicar.



FIG. 88. Vicar.

<sup>1</sup> "The Pear and How to Grow It." Farmers' Bulletin 482. U. S. Department of Agriculture.

<sup>2</sup> "Nomenclature of the Pear." Bulletin 126, Bureau of Plant Industry.

abundance of small green or brownish dots. Shape, very long pyriform. Calyx open. Basin wide and shallow. Stem light, about  $1\frac{1}{2}$  inch in length, fleshy at base, emanates from one side. Cavity small or absent. Quality poor to medium. The trees that have been observed in California are large and productive. The fruit is beautiful but not desirable except for cooking purposes. A winter variety that keeps until after the holiday season.



FIG. 89. Leaf of Vienne.



FIG. 90. Vienne.

#### Vienne.

Origin France. Size medium. Color green or light yellow, slight blush; sprinkled with russet. Shape obtuse pyriform. Calyx open. Basin medium. Stem  $1\frac{1}{4}$  inch or more. Cavity wide and very shallow. Quality medium to good.

**White Doyenne.**

Origin France. Size medium. Color whitish yellow with very small brown dots. Shape roundish obovate. Calyx closed or partly open, small, set in shallow basin. Stem  $\frac{3}{4}$  inch to  $1\frac{1}{4}$  inch long. Cavity small, round. Quality good. Season medium early.



FIG. 91. Leaf of White Doyenne.

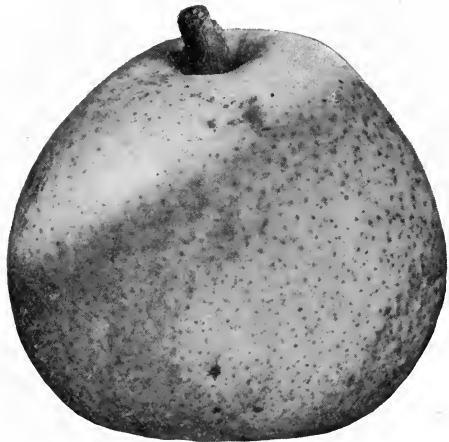


FIG. 92. White Doyenne.

**Wilder Early (American).**

Size small to medium. Color yellow with red cheek. Flavor sweet and good. Recently introduced and profitable for local sale in San Diego County. Should not be confused with Col. Wilder, a California seedling which has gone out of use. (Description by Wickson.)\* This variety has recently become quite popular for planting in Solano and Placer counties. It ripens early, being practically off the market before the Bartlett begins. Quality good.

\* "California Fruits," seventh edition.

**Winter Bartlett.**

Origin Oregon. Size large. Color light yellow like Bartlett, splashed with russet. Skin contains green or brownish dots. Surface uneven. Shape oblong pyriform. Quite like Bartlett. Calyx closed. Basin small, shallow and very irregular. Stem heavy,  $\frac{3}{4}$  to  $1\frac{1}{4}$  inch in length. Cavity small and often one-sided. Quality medium. Season late.

This pear has been planted in a small way in California. In the Imperial Valley it has been grown more or less successfully for some years and is the best variety known at present for that section. For a late winter pear it may become of some value in the state. At present it is being grown north of Tehachapi mostly in an experimental way.

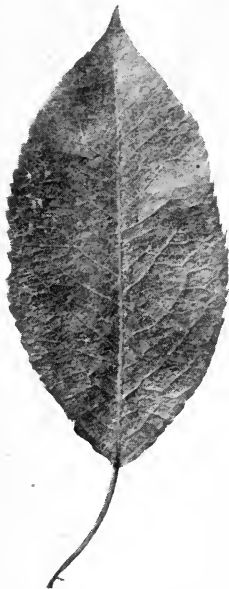


FIG. 93. Leaf of Winter Bartlett.



FIG. 94. Winter Bartlett.

**Winter Nelis.**

This variety originated in Belgium. Fruit usually medium or small in size, variable. Color green or light yellow when ripe. Skin smooth, splashed and streaked with a heavy brown russet. Shape roundish obovate. Open calyx is set in a medium sized, regular shaped basin. Stem rather slender and the average length, about  $1\frac{1}{2}$  inch. Cavity very small. Quality very good to best. This variety ranks, as a winter pear, with the Seckel, which is so popular in the fall. Flesh fine grained, sweet, juicy, buttery, and pleasing in flavor. There is practically no aroma.



WINTER NELIS



The trees become large and are quite hardy although blight affects them commonly. The twigs are brown in color and have the habit of twisting into various shapes. They have the tendency to grow long and slender. From the standpoint of production this variety is, under most conditions favorable to pears, all that could be desired. Without thinning and proper pruning the fruit is apt to be small.

In California there is no better pear on the market, during the holiday season, than the Winter Nelis. On December 27, 1916, the writer made an investigation of the San Francisco markets to determine what varieties of winter pears were being sold during the holiday season.



FIG. 95. Leaf of Winter Nelis.

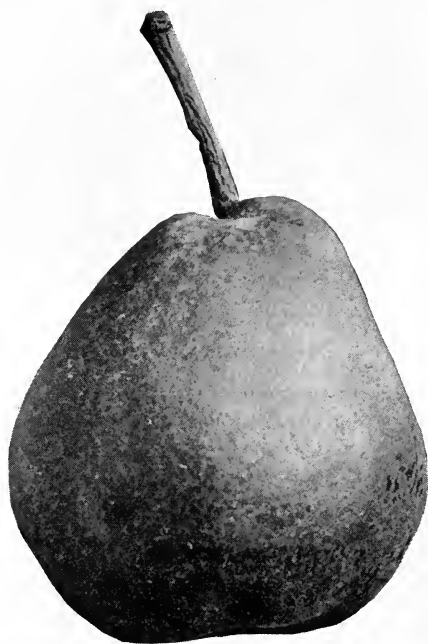


FIG. 96. Winter Nelis.

The following notation was made on that date: "There was a noticeable scarcity of all varieties, but the following were found in small numbers: Anjou, Winter Nelis, Easter Beurre, Pound, Clairgeau, Vicar of Wakefield and Kieffer. Winter Nelis were selling for from \$2.00 to \$3.00 per box; Clairgeau, Easter Beurre, Kieffer and Pound for from 75 cents to \$1.25 per box. Three pears of the Pound variety were bought from a fruit vendor who has a stand near the Ferry Building, for 10 cents. They were hard and nonedible. Three Anjou pears were bought at a fruit stand in the Ferry Building, for 10 cents; these were excellent for eating. They were grown in Oregon." Of all the varieties seen during this investigation only Winter Nelis and Anjou were worthy of the name pear. There should be a good winter market

for well-ripened specimens of these two popular varieties. On March 30, 1918, well-ripened Winter Nelis in prime condition were bought from a fruit dealer in Los Angeles.



FIG. 97. Splendid type of Winter Nelis tree growing in Santa Clara Valley.

#### Worcester.

Origin unknown. Size large. Color green, covered with russet. Dots large brown, obscured by russet. Shape obtuse pyriform. Calyx open. Basin small, shallow, irregular. Stem heavy,  $1\frac{1}{2}$  inch or more long. Quality poor. Good only for cooking. Season late. Little grown in California. Considered desirable for culinary purposes in the London markets.

#### Zoe.

Origin unknown. Size small to medium. Color light yellow with red blush. Shape oblong pyriform. Calyx open. Basin small. Stem  $\frac{3}{4}$  inch to 1 inch long. Cavity small. Quality medium. Season late.

In addition to the list of varieties described there are a number that originated in California, but which are not included because as far as could be determined they are not being grown to any extent at this time, after having been given a thorough trial in years gone by. Among these are Acme, Bergamota, Block, Crocker Bartlett and Napa.

The following tables are designed to show, in the case of the first, the quality of varieties regardless of locality, or any of the other factors which enter into commercial pear culture, and in the case of the second the adaptability in a commercial sense to the pear growing regions of the state, which are defined at the close of the Introductory Chapter.

Necessarily tables of this nature are only approximately correct, and it is not expected that everyone will agree in the data which they set forth. In order that the opinion of those who are best capable





FIG. 98. Leaf of Worcester.

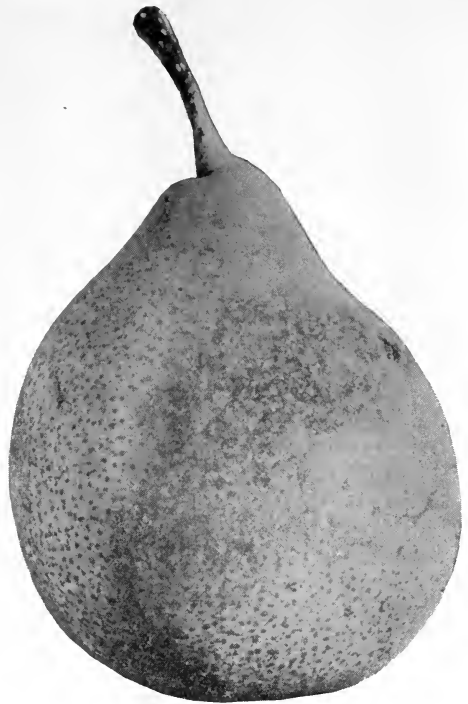


FIG. 99. Worcester.

of judging might be represented the tables have been submitted to a number of pear experts for criticisms and corrections. Thus, they do not represent the writer's views alone, but rather the composite view of those who had a part in their preparation.

It will be noticed in the quality table that Bartlett is rated only as very good. Commercially there is no one who would rate it lower than best, but when quality alone is being considered there are few people who would place it in the same class with Seckel, Bosc and Comice. Because of its commercial importance it was taken as a standard by which to judge other varieties and each has been rated above or below according to the best judgment that could be secured on quality.

It will also be noticed in the table that certain varieties are rated as both very good and best, or good and very good, or medium and good; for example, Comice, Rossney and Easter Beurre. This simply means that under certain conditions these pears are rated higher in quality than under other conditions and may vary from very good to best, or from good to very good, or from medium to good.

The adaptability table was even more difficult to prepare. It is far from being complete and no doubt many varieties listed will do well in districts from which they have not been reported. Again, in the course of preparation of this table every effort was made to secure reliable data and it will at least serve as a guide in the selection of such varieties as are at present known to be adapted to the several districts of the state.

TABLE SHOWING QUALITY OF VARIETIES.

	Best	Very good	Good	Medium	Poor
Angers				×	
Angouleme (Duchess)			×		
Anjou		×			
Bartlett		×			
Bloodgood			×		
Bordeaux				×	
Bosc	×				
Boussock			×		
Bretonneau					×
Cardinal (Georg d'Ambois)		×			
Clairgeau			×	×	
Clapp Favorite			×		
Comice	×	×			
Cook (A. J., new variety)			×	×	
Dana's Hovey	×	×			
Dearborn Seedling			×		
Diel (Beurre Diel)				×	
Dix				×	
Easter Beurre			×	×	
February Butter					×
Flemish (Flemish Beauty)			×		
Forelle			×	×	
Gaillard			×	×	
Garber					×
Giffard			×		
Glout Morceau				×	
Hardy (Beurre Hardy)		×	×		
Heyst (Emile de)				×	
Howell		×	×		
Idaho			×	×	
Joan of Arc		×			
Kieffer					×
Lawrence		×	×		
Lawson (Comet)				×	×
Le Conte					×
Le Lectier			×		
Louise Bonne			×		
Lucrative (Belle Lucrative)				×	
Madeleine			×		
Marguerite Marillat		×			
Mount Vernon		×	×		
Onondaga				×	
P. Barry				×	
Philopena				×	
Pound					×
Rossney		×	×		
Seckel	×				
Sheldon			×		
Souvenir (Souvenir de Congress)					×
Superfin		×	×		
Touraine				×	
Tyson				×	
Urbaniste				×	
Vanille				×	
Vicar (Vicar of Wakefield)				×	×
Vienne			×	×	
White Doyenne			×		
Wilder Early			×		
Winter Bartlett				×	
Winter Nelis	×	×			
Worcester (Black Pear of W.)					×
Zoe				×	

Table Showing Adaptability of 25 Leading Varieties of Pears in the Different Regions of the State.

	Northern California Coast Region-----	Central California Coast Region-----	Southern California Coast Region-----	Northern and Central California Interior Valley Region-----	Southern California Desert Region-----	Imperial Valley Region-----	Sierra Nevada Foot- hill and Mountain Region-----	Modoc-Inyo Region-----
Angouleme -----	†	†	†	†	†	†	****	†
Anjou -----	**	**	†	***	***	†	**	†
Bartlett -----	*	*	*	*	*	***	*	*
Bosc -----	*	*	†	***	*	†	*	†
Clairgeau -----	***	***	†	***	†	†	***	†
Clapp Favorite -----	***	***	†	***	†	†	***	**
Comice -----	*	*	†	***	†	†	**	†
Dana's Hovey -----	**	***	†	†	†	†	**	†
Easter Beurre -----	**	**	***	**	†	†	***	**
Flemish -----	***	***	†	***	†	†	***	***
Forelle -----	†	***	†	***	†	†	**	†
Glout Moreceau -----	**	***	†	†	†	†	***	†
Hardy -----	**	**	†	**	†	†	**	†
Howell -----	***	***	†	***	***	†	***	†
Kieffer -----	***	****	†	***	***	***	****	***
Lawrence -----	†	***	†	**	†	†	***	†
Lawson -----	†	***	†	***	†	†	****	†
Louise Bonne -----	†	***	†	**	†	†	***	†
Mount Vernon -----	†	†	†	†	†	†	***	†
Rossney -----	†	***	†	**	†	†	***	†
Seckel -----	†	*	*	*	**	†	***	*
Vicar -----	†	***	†	***	†	†	***	†
Wildor -----	†	***	†	***	†	†	***	†
Winter Bartlett -----	****	†	†	†	****	*	****	†
Winter Nelis -----	*	*	***	**	**	†	**	**

†Not reported as being of any value in this region.

\*Best.

\*\*Very good.

\*\*\*Good.

\*\*\*\*Medium.

\*\*\*\*\*Poor.

## CHAPTER III.

## TREES, STOCKS AND PROPAGATION.

## STANDARD TREES.

The planter has his choice of two general classes of pear trees designated as standard and dwarf. The former consist of known varieties budded or grafted into seedling roots, which may be produced from seeds of any of the cultivated varieties but which are usually of European or Asiatic origin. The wild pear of Europe (*Pyrus communis*), has been used almost entirely in the past for propagating standard trees. The nurserymen, as a rule, have bought what are known to the trade as French seedlings, getting them directly from France, where



FIG. 100. Water sprouts at the base of Bartlett tree, illustrating the tendency of the French root *Pyrus communis* to develop an abundance of succulent sprouts.

they are grown in great quantities for importation into the United States. Large nursery companies contract for them and in turn supply the smaller nurserymen. These seedlings are planted in the nursery row and are later budded or grafted with the desired variety. A large, vigorous tree results if stock, soil and climatic conditions are favorable. The Asiatic wild species of pear, formerly called *Pyrus sinensis*, but now known to be *Pyrus serotina*, has been successfully used in propa-

gating standard trees, and possesses certain merits which will undoubtedly make it more popular than the French species in the future, unless some undesirable characteristics, which at present are not known, should develop. In addition to *Pyrus serotina*, there are a number of other species grown in China and Japan, some of which are mentioned in connection with the discussion of varieties and species resistant to pear blight. The French stock has a tendency to produce an abundance

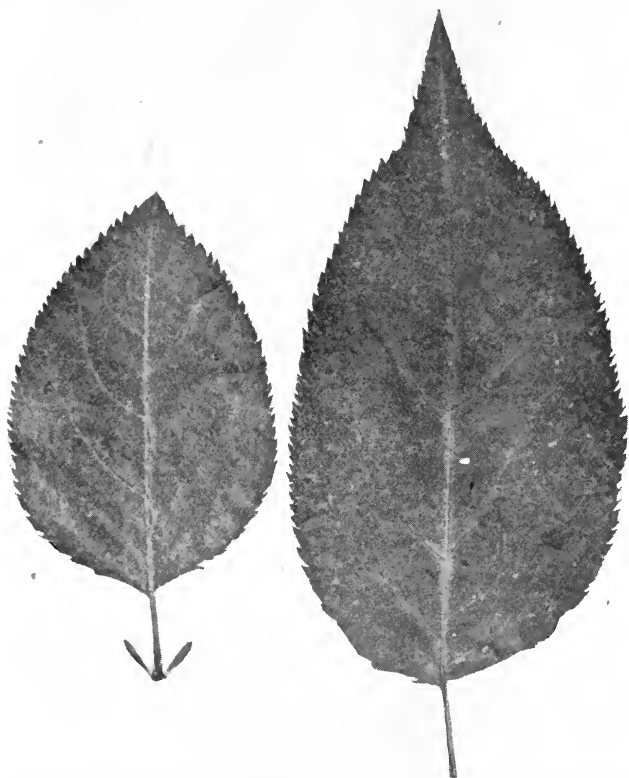


FIG. 101. Large leaf from Japanese seedling, *Pyrus serotina*; small leaf from French seedling, *Pyrus communis*, showing the characteristic shape and serration.

of water sprouts, which often completely surround a tree in a dense thicket-like mass. This unfavorable characteristic, which is not possessed by the Asiatic or commonly called Japanese stock, that has been used for propagation in this country, has a direct bearing on the worst disease of the pear, viz: blight, as the growth coming directly from the roots often becomes infested with aphids, thrips, or other insects or mites and the disease is carried into the root system, where control is exceedingly difficult and expensive and eradication is scarcely possible. In addition to the absence of water sprouts with *Pyrus serotina* stock, it is much more desirable than *Pyrus communis* because it is now known to be highly resistant to blight. This phase of the subject is fully treated in chapter on fungous diseases in connection with the pear blight discussion.

There is a marked difference in appearance between the French and Japanese seedlings. The leaf of the former is much smaller, more round or heart-shaped and has a characteristic serration of the margin,



FIG. 102. Fruit from Japanese seedling pear, *Pyrus serotina*.

which is less prominent and otherwise quite different from the Japanese, which also possesses a characteristic shape and serration. The leaf of the Japanese stock is much larger. The apex is long, narrowing gradually to a sharp point, while the apex of the French leaf is quite blunt. The differences between the two are very clearly illustrated in Fig. 101.

#### DWARF TREES.

Dwarfing of standard varieties of pears has been practiced to a limited extent for a long time. In California the writer has observed two very successful orchards of dwarf trees, viz: the Block orchard at San Jose and the Frank T. Swett orchard at Martinez. Both orchards are heavy and consistent bearers. The dwarfing is brought about by the use of the quince root. The variety known as *Angers* is commonly used. Trees should be double-drafted, as in the case of the Swett orchard, which has a quince root system, Hardy trunks and Bartlett tops. The double-working is practiced because of the fact that the Bartlett variety does not make a good union with the quince. The growth at best is apt to be very unsatisfactory and breaking off at the union of Bartlett with the quince is apt to take place during a high wind. There are advantages and disadvantages of the dwarf trees. They come into bearing earlier than standards and being small they are more easily sprayed and pruned; blight, when it occurs in the branches, can be removed with less trouble and expense, and picking is greatly facilitated. In sections of heavy winds dwarfs may be grown to good advantage, provided that stock has been used which has made a perfectly satisfactory union with the quince and provided they have been planted sufficiently deep to protect the union. The disadvantages usually given are included in their lack of hardiness, and supposed tendency to be

short-lived. This tendency is without doubt overcome to a large extent by the use of congenial stocks and the proper care of the orchard. There is no logical reason why dwarf pears should not possess as great longevity as standards and the two orchards mentioned indicate that in California there need be no hesitancy about planting dwarfs because of a fear that they will not live long. The possible inferiority of the fruit of some varieties as compared to that grown on standard trees has been suggested. As many more can be planted to an acre than in the case of standards, the production is often greater. Deep planting may cause the growth of roots from above graft, and a tree possessing both dwarf and standard roots will result. Such trees are not objectionable except that if planting has been done at distances suitable only for dwarfs, heavy pruning will be required to keep them within bounds.

### SEEDLINGS.

The two kinds of seedling trees commonly called French and Japanese, but more accurately *Pyrus communis* and *Pyrus serotina*, have already been mentioned, and some of the merits and faults of each discussed. There are very few nurserymen in this country who grow their own seedlings for propagating purposes, but if one desires to do so little difficulty need be experienced. Desirable seeds well matured from any variety may be chosen. The trees which will result from the planting of seeds of a known variety will vary widely, and some may not be good stock. For example, if Bartlett seeds are used, each tree grown from them will probably be very different from the Bartlett; no two will have the same characteristics, and the stock resulting is not liable to possess either the uniformity or desirability of the seedling stock of the wild species. If seeds of either *Pyrus communis* or *Pyrus serotina* can be secured, or if it is thought advisable to plant seeds of some of the improved varieties of the pear, it is not a difficult matter to get them to grow. The following method of treating the seed and seedlings after they have grown is recommended:\*

"The seeds should be stratified, *i. e.*, mixed in alternate layers of moist sand in a box, covered securely to guard against rats and mice, and the box should be placed on the north side of some building where it will be exposed to freezing and thawing throughout the winter until the time of planting. If the seeds are planted in rows three feet apart in good soil, and given thorough culture, they will make a sufficient growth in one season for budding or grafting. If wanted for root grafting the seedlings should be taken up in the fall and stored in a cellar where they will keep fresh and be accessible at any time during the winter; if wanted for budding they may be buried in the soil outside until the time of planting in the spring, when they may be set in nursery rows four feet apart, with the plants ten inches apart in the row."

### BUDDING.

The most popular and undoubtedly the best method for making the seedling over into the improved variety selected is budding, and practically all nurserymen adopt this plan rather than the old method of

\*Farmers Bulletin 482 of the U. S. Dept. of Agriculture, by G. B. Brackett.

root grafting. In the budding method the seedlings, without being removed from the nursery row in which they are growing may have inserted into them the buds of the future commercial tree. Such work is usually done in the fall, August and September being the best months. A limited amount of budding is done during the month of June. The operation is simple, results in little or no injury to the tree, and there

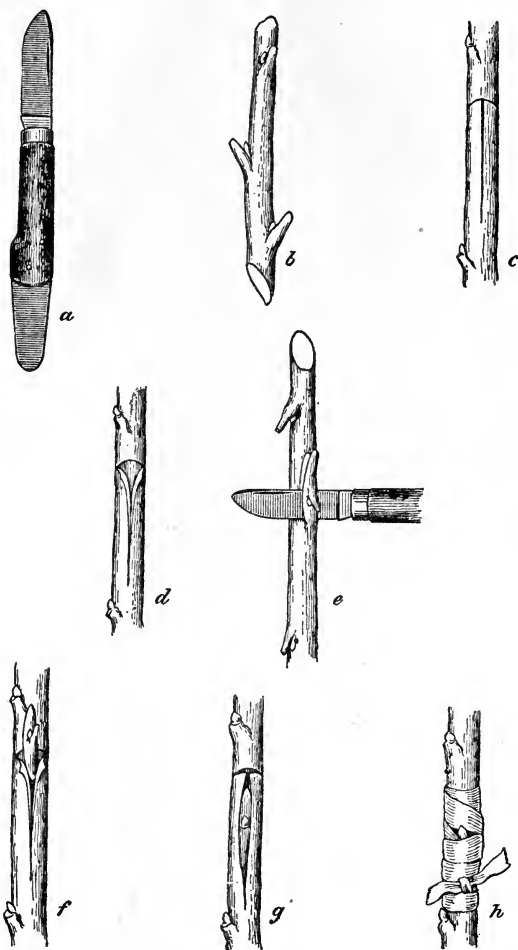


FIG. 103. Budding knife, bud sticks, and the operation of budding. (Recopied from Farmers Bulletin 482, U. S. Department of Agriculture, by G. B. Brackett.)

is good reason to believe minimizes the amount of crown gall trouble which often develops at the point of union of a graft with the seedling root. Fig. 103 shows a budding knife and the method of cutting, inserting and tying the bud. The latter operation is of great importance, and often the failure of buds to grow is due to poor tying.



A striking illustration of this fact was brought to the writer's attention while conducting an experiment in the fumigation of peach nursery buds, in a Maryland nursery, to destroy San Jose scale, and to determine the strength of gas that the buds would stand. A number of bud sticks were treated with heavy doses of hydrocyanic acid gas, and the greatest of care was exercised in tying the buds after insertion. The work was done by colored help who were anxious to please because of an expected tip. As a result of the exceedingly careful work, especially that of tying the buds securely to the stock practically 100 per cent of a stand was secured. Rows alongside in which untreated buds were inserted, but without the same care in placing and tying, had little more than 50 per cent of a stand. This illustration, while it concerns peaches, will no doubt apply equally as well in the case of pears, and shows the necessity for careful work in budding, which is sometimes sacrificed for speed. Buds are tied either with a fiber, called raffia or cotton twine, which is removed in the spring. They remain green throughout the winter months if a satisfactory union has taken place. The tops of the seedling trees are removed just above the bud early the following season, before growth begins, then all the strength of the root system is utilized in the development of a top from the bud.

Bud-wood should be carefully selected, well matured, and above all from trees that are known absolutely to be of the variety desired, and if possible, which have had a good record of production to recommend them. Water-sprout growth should be used with caution, as the buds of such branches are invariably weak. The biggest and strongest-looking buds on thrifty average length, current year growth of bearing trees, are the most desirable. The practice of securing bud-wood during the time of pruning in young orchards, which have made a rank growth and which have never borne, is wrong and should be condemned. In the first place, if this is done, the bud-wood is not of the best and the nurseryman can hardly afford to take the chances of his stock not being true to name. At the present time there is a law in California which makes it a misdemeanor to sell stock not true to name, and violations are punishable by a fine of not less than \$50 and not more than \$500, or by imprisonment in the county jail for not less than twenty days or more than six months, or by both fine and imprisonment. Thus the nurseryman, in addition to losing his reputation by selling trees of one variety for another, is laying himself liable to a heavy fine and imprisonment. With these facts before him, the California nurseryman must exercise the greatest of care in the selection of buds from known varieties. The better class of nurserymen recognize this fact more keenly than any one else, but the few who are in the business merely for the dollars that they get out of it, and who care little for the future of the fruit industry of the state, are apt to follow the lines of least resistance and in doing so fail to take the precautions necessary for the protection of the grower who makes his lifetime investment in an orchard and who therefore is entitled to great consideration.

## ROOT GRAFTS.

Propagation by root grafts requires the seedling trees grown exactly as those for budding. The seedlings must be removed from the ground in the fall, and placed where drying out will not take place during the winter season. Grafting wood for the tops should be cut in the fall also, and preserved in a like manner. A common method is to keep both scions and seedlings in a damp cellar, moist sand being one of the best protective materials. Just as great care should be exercised in the selection of the grafts or scions, as in the case of the bud-wood.

The work of root-grafting may be done any time during the dormant season of the trees, the only precaution necessary being that of keeping them from drying out. The method generally used is known as whip-grafting, and consists in cutting the seedling just below the crown or ground line, as indicated in Fig. 104, and fitting the scion, similarly cut, into it so that the cambium layer of the scion on one side of the completed graft matches as closely as possible that of the seedling.

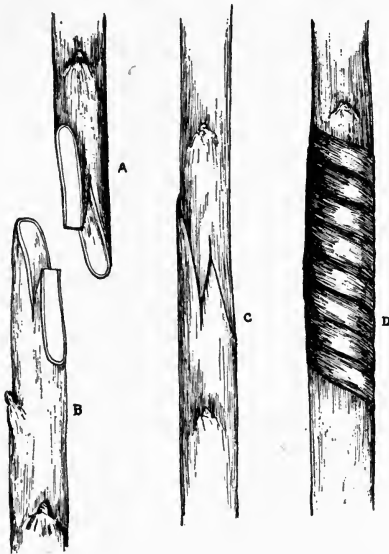


FIG. 104. Operation of whip grafting. (Redrawn, by O. W. Newman, from Downing's "Fruits and Fruit Trees of America.")

These scions may vary somewhat, but the length generally recommended is about six inches. The whole root system of the seedling tree should be used, with the exception of injured roots, which should be removed. Piece root-grafting, as frequently practiced with the apple, is not recommended for the pear.

After fitting the scion and rootstock together they should be held securely in place by cord, wax, wax paper or a combination of these. It must be remembered that any material used for tying can not well be removed after grafts are planted, so it is necessary to use something that will rot quickly and thus eliminate the

danger of injury to the tree. Frequently trees are seen that have been tied, when grafted, with strong waxed thread or twine which does not rot, and as a consequence the flow of sap is interfered with and there results an enlargement of the tree at point of union, or even girdling, and the subsequent death of the tree. For this reason tying should be carefully done, using no more twine than is necessary. Cotton knitting thread, Nos. 18 or 20, is recommended. Tying of the thread is not necessary as the end may be pulled into the cut of the whip graft. Waxing over the surface of the twine is frequently practiced; also waxing the twine before use, which precludes the necessity of tying.

Root-grafts are set out in the nursery row in the spring and will develop tops of sufficient size for planting in the orchard the following spring, making the one-year-old tree which is recommended under practically all conditions in California.

## CHAPTER IV.

## SELECTION AND CARE OF TREES FOR PLANTING.

In buying trees it is well first of all to know the nurseryman with whom one is dealing, and to insist upon good stock. Such stock usually sells for a good price. The man who buys cheap trees is laying the best possible foundation for a cheap orchard, as cheap trees, in practically every case, are inferior trees. This rule is, of course, subject to exceptions, as it frequently happens that very large two or three-year-old trees are sold for a high price simply because of their size, even though they are usually inferior to smaller trees. Generally speaking the trees that are quoted at very low figures are culls which have failed to develop in the nursery as other trees grown under exactly the same conditions, or trees which have had a large part of the root-system cut away in digging. Such stock is often inherently weak and will never make first-class trees in the orchard. The best trees are those that have had one year's growth in the nursery, after budding or grafting has been done. Under ordinary conditions the tops of such trees are unbranched and are what the nurseryman knows as one-year whips.

Varieties should be chosen according to the best knowledge that can be obtained as to their adaptation to the existing conditions of the locality where they are to be planted. In nearly every neighborhood there are bearing trees of various sorts which will serve as a guide in selecting for the orchard. Those that are known to do well under similar conditions can be safely selected; those that are a failure should not be considered. If no bearing trees can be found conclusions may be drawn after finding out what varieties do well elsewhere under similar conditions of soil and climate. In California the Bartlett is by far the most popular pear, and generally speaking the choice of varieties is difficult only in the case of selecting a few trees of some other kind to plant with the Bartlett for the purpose of cross-pollination. As this matter will be discussed fully under the heading of "Varieties" it is not necessary to dwell upon it further here.

## FREEDOM FROM DISEASE AND INSECT PESTS.

Pear trees are subject to attack by some very serious diseases and insect and mite pests. All stock should be carefully examined in order that the presence of anything detrimental might be detected. The county horticultural commissioners and their inspectors are constantly on the lookout for these things, but the planter himself, when he purchases trees, should also inspect them so carefully that he will know just exactly their condition. Such pests as borers and crown gall are easily detected, and affected trees when found should be condemned for planting. The roots should be examined very carefully for the woolly or root aphid of the pear, which is one of the most serious pests attacking this tree. A description of this insect may be found in the chapter dealing with insect pests. If this pest is known to occur in the nursery where the

trees were grown safety would require their treatment by dipping in a solution of Black Leaf "40," or, still better, fumigation with hydrocyanic acid gas. See formula No. 19.

#### **DIGGING AND CARE OF NURSERY TREES BEFORE THEY REACH THE PLANTER.**

The nurseryman's responsibility for the character of the orchards that are grown from trees that he propagates is very great. When we stop to consider the fact that practically all of the orchards are grown from trees that are propagated by nurserymen whose duty it is to know that the trees sold are true to name, free from dangerous insect pests and disease, etc., we can begin to realize that the nurseryman's trade is one of great importance, and that the man who conducts a reputable business represents a type of public servant who is of inestimable value to the horticultural industry of the state or locality where he conducts his business. Conversely the nurseryman who is not reliable and who thinks only of the present and the few dollars that his trade brings him represents a public menace in that he retards the progress of horticulture through the dissemination of his inferior stock.

##### **Digging.**

This operation is of much importance, owing to the fact that the condition of the root system is largely dependent upon how the trees are dug. The type of digger used in most of the nurseries consists of a large plow with a more or less semicircular blade which cuts the roots at any desired depth and lifts the trees partially from the soil so that they can be easily pulled by hand. If diggers are run too shallow the roots that are left on the trees are too short, and what might have been first-class trees, if properly dug, are second rate.

At the time of pulling, trees can easily be inspected for crown gall, nematodes, borers, etc. Most of the nurserymen plan to throw out all inferior trees at this time previous to tying in bunches of ten or twenty.

##### **Fumigation.**

The freshly dug trees after having been tied in bunches may be hauled to the fumigating house where treatment for the pear root louse, scale insects and other insect pests takes place. The value of fumigation must not be minimized. When efficiency, cheapness and convenience of the fumigation operation are taken into consideration, there is nothing that will compare favorably with it for the treatment of nursery stock.

##### **Fumigating Buildings and Boxes.**

For the fumigation of nursery stock the all important requisite is a perfectly tight box or house in which the gas can be confined for any desired length of time without leakage. In order that this may be possible careful construction is necessary. The usual fumigation house consists of double boarded walls with heavy building paper between. Doors of the type used on refrigerator cars are best. After a building has been constructed the measurements must be carefully taken and the cubical contents determined accurately.

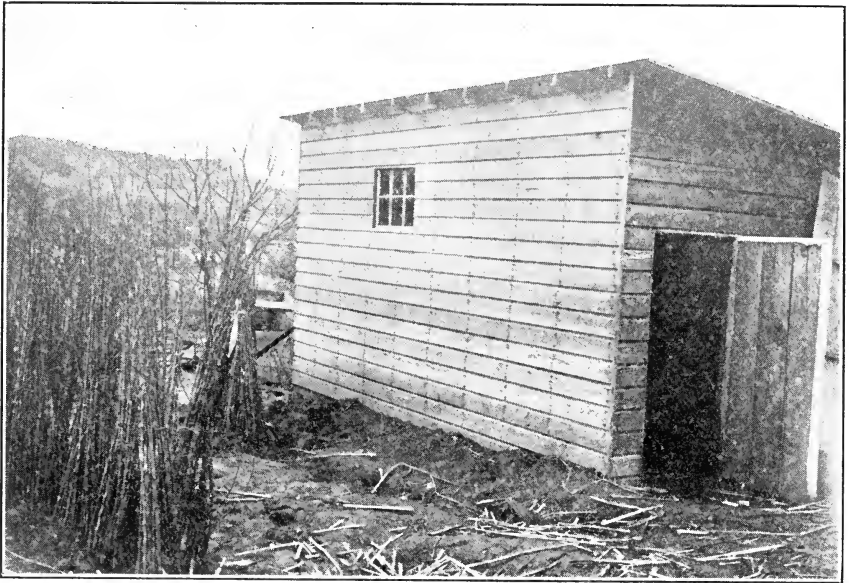


FIG. 105. A good type of fumigation house.

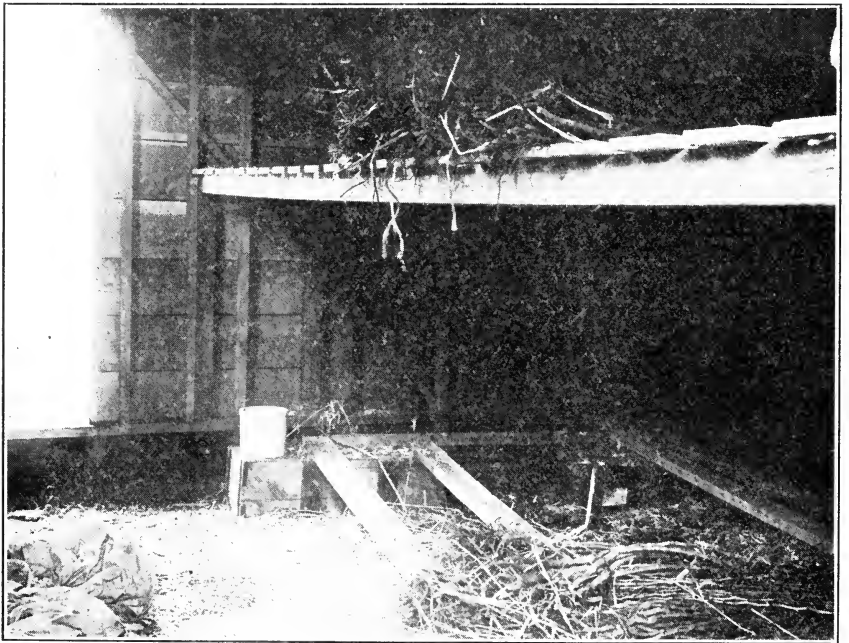


FIG. 106. Interior view of fumigation house shown in Fig. 105. Note the platform built midway between the roof and the floor, also the generating jar in background near the door.

Fig. 105 shows a picture of the fumigating house of the Silva-Bergtholdt Nursery Company of Newcastle. The heavy door with padding to insure against leakage in gas is clearly shown. The interior view, Fig. 106, shows a platform erected midway between the floor and ceiling to prevent too close packing of the lower bunches of trees from the weight of bunches above with the possible interference with the diffusion of the gas. This feature, while not absolutely necessary, is desirable.

In the larger nurseries a house of sufficient size so that a loaded wagon or auto truck could be driven into the house and fumigated without unloading the trees would be a decided advantage.

#### Fumigation Process.

An earthenware jar of sufficient capacity for the house is used as a container for the chemicals which generate the gas. When the building is packed with trees ready for fumigation the required amount of cyanide of potassium or cyanide of sodium, accurately weighed, is dropped into dilute sulphuric acid of the proper amount. The proportions are 1 ounce by weight of cyanide of potassium, 1 fluid ounce of sulphuric acid and 3 fluid ounces of water for every 100 cubic feet of space, or  $\frac{3}{4}$  ounce by weight of cyanide of sodium,  $1\frac{1}{2}$  fluid ounces of sulphuric acid and 2 fluid ounces of water to every 100 cubic feet of space.

#### Method.

First measure the required amount of water and put it in the generator, then measure the acid and pour it into the water. Never reverse this process, as water poured into acid will cause a violent sputtering which may injure the operator. The house should now be tightly closed with the exception of one door near the generator. Everything being in readiness, the cyanide of potassium or sodium, according to which is used, is dropped into the jar and the remaining open door quickly closed. The gas escapes immediately when the cyanide is dropped into the generator and may be seen as a cloud of vapor rapidly ascending to the ceiling. The house must be left tightly closed for at least 45 minutes, and no injury will result to trees from a one-hour fumigation. They should not be left in a longer time than one hour. After 45 minutes to one hour have elapsed the doors are thrown wide open and the gas escapes from the building quite rapidly.

#### Caution.

Hydrocyanic acid gas, the product of the treatment of cyanide of potassium or cyanide of sodium with sulphuric acid, is a deadly poison and is fatal if inhaled in small quantities unless very dilute. In the open air there is little danger but when confined in a building where it is very concentrated one deep breath would almost surely result in the death of the person inhaling. Therefore men should never be allowed to remove trees from a fumigation house until it has been aired fifteen minutes, or more. With ordinary precautions the gas may be used with safety as attested by the general fumigation of thousands of acres of citrus groves every season with rarely an accident or a death from the inhalation of gas.

The cyanide is also a deadly poison and must be handled with great care. It should never be placed within the reach of children as the tempting crystals might easily be mistaken for candy, but a piece, if put into the mouth, would cause almost instant death.

#### Care of Trees After Delivery.

There are hundreds of cases of trees dying after they have been set in the orchard, where the blame for their loss has been unjustly attached to the nurseryman. In handling trees it must be remembered that it is unnatural for the root system to be exposed to the air, and every precaution possible should be taken to prevent unnecessary exposure, which will quickly cause a loss of moisture and possible death. While trees will stand considerable exposure, and while roots may become reasonably dry and still grow when covered with soil, the ideal condition for them occurs only when moisture is present in sufficient quantities so that the surface of the bark will not become dry and shriveled. Yet so many nurserymen and orchardists thoughtlessly or otherwise allow the roots to be exposed during warm weather until they become thoroughly dried out, and later wonder why the trees fail to grow. Just as soon as a lot of trees is unpacked upon arrival at their destination the roots should be covered in trenches, a process known as "healing in." In the trenches trees may be crowded close together, as it is not expected that they will be left long enough for roots to start growth, but merely until the orchard is ready to receive them. While heeled in they must, however, be kept moist and under just as favorable conditions as in the orchard.



## CHAPTER V.

## DISTANCE AND SYSTEMS FOR PLANTING AND NUMBER OF TREES PER ACRE.

There has been a tendency in the past to plant all fruit trees too close together. This has been brought about because of a desire to attain the maximum production, which has very frequently been secured at the expense of size, uniformity and quality. As most varieties of the pear naturally grow upright, trees may be planted closer together than many other deciduous trees, *e. g.*, apples, peaches and apricots. This tendency of upright growth may be overcome to a large extent by proper methods of pruning as discussed in another chapter. With the present methods employed in pruning our Bartlett pears the majority of the growers have concluded that 20 x 20 feet is the best distance. Out of a total of 72 owners of pear orchards in the counties of Alameda, El Dorado, Lake, Mendocino, Napa, Placer and Sacramento, thirty-one preferred this distance. Among those who favored some other distance were three who thought 21 x 21 feet to be best, six 22 x 22 feet, seven 24 x 24 feet, four 25 x 25 feet, two 26 x 26 feet, one 27 x 27 feet and one 30 x 30 feet. The remainder held opinions varying from 16 x 16 to 18 x 20 feet. The maximum distance of 30 x 30, as given by one grower as the best according to his opinion, is probably a little greater than is necessary. Twenty-five feet each way when planted on the square is more nearly ideal, and while the space above ground will be pretty well occupied by the branches of trees set at this distance, there will be little if any crowding. The upright habit of growth occurs in its extreme form when planting is closest, and may be overcome to a great extent by planting wider apart. Fig. 12 illustrates an extreme type of spread in the Bartlett due to good soil and plenty of room.

Climatic and soil conditions should very largely determine the distance for planting. In some of the mountain counties of high altitude the growing season is short and growth is much less than in the lower, fertile, river-bottom sections, where maximum size is attained. In the first case it might not be best to set trees over 18 feet apart each way, while in the latter 25 x 25 feet would in many cases be more advantageous. From observations that have been made in all the pear-growing sections of the state, and from correspondence with many of the leading growers, the distance of 20 x 20 feet has been decided upon as being best for standard trees under practically all conditions. When planted at this distance there are 108 trees to the acre.

Occasionally it is desired to interplant in a pear orchard with peaches, prunes or other trees. In such cases the pear trees should be set not closer than 30 feet each way on the square; in the middle of each square a tree of the filler desired may be set, which will be 21 feet from each tree on the four corners of the square. As the pear tree comes into profitable bearing quite early (five to seven years) there is little advantage to be gained by the use of fillers, and the practice of placing them

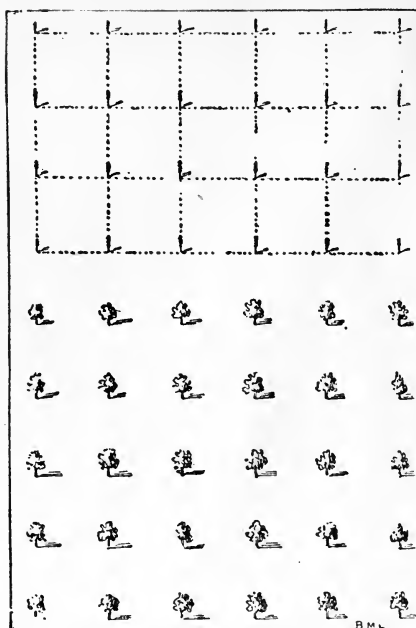


FIG. 107. The square system of planting. (After Lelong.)

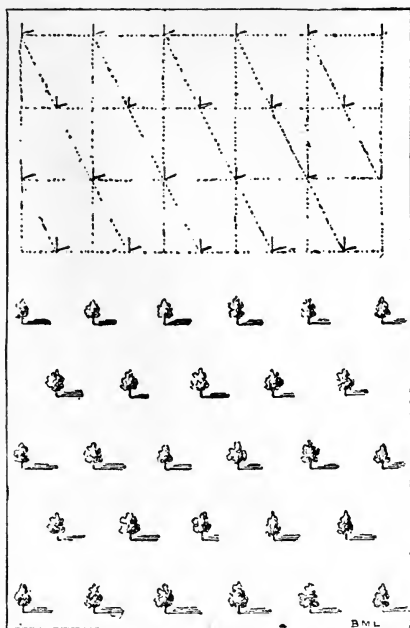


FIG. 108. The triangular or alternate system of planting. (After Lelong.)

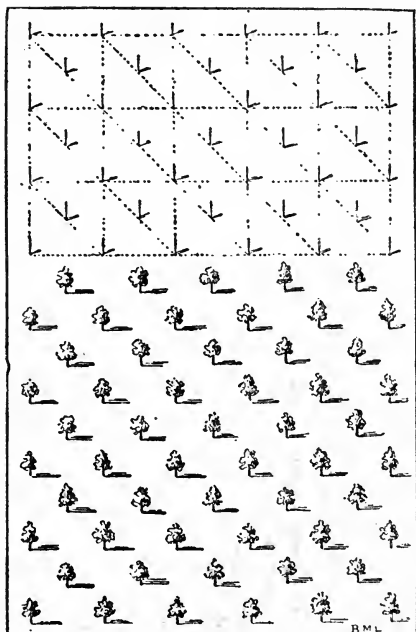


FIG. 109. The quincunx system of planting. (After Lelong.)

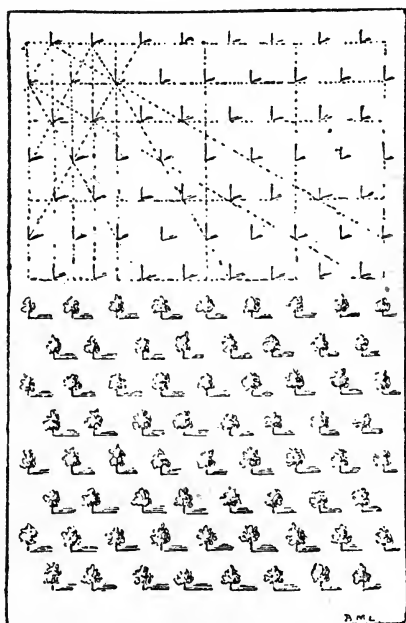


FIG. 110. The hexagonal system of planting. (After Lelong.)

in the pear orchard is not recommended. Dwarf pears are ordinarily planted from 10 to 12 feet apart; if the former distance, there would be 435 to the acre; if the latter, there would be 302 per acre.

#### SYSTEMS FOR PLANTING.

Four systems of planting trees, designated as square, triangular, quincunx and hexagonal, are well illustrated in Figs. 107, 108, 109, 110, after Lelong. The first or square system is the most commonly used. Marking the area for planting is easiest under this system, and it has the advantage of allowing plenty of room for hauling, cultivation and other orchard operations between the rows in two directions in the relatively wide spaces at right angles to each other.

The hexagonal system is recommended by many, its chief advantage being in the fact that every tree is equidistant from all adjacent trees, and about 15 per cent more trees can be set to the acre. With this system the space above ground occupied by the tops of the trees, and below ground by the root systems, should be utilized to best advantage; but the absence of wide spaces between the rows makes it impractical from the standpoint of many growers, as cultivation, hauling and all other work of the orchard requiring the use of teams or tractors is complicated.

#### NUMBER OF TREES PER ACRE.

In an acre of land there are 43,560 square feet, and in order to determine the number of trees required per acre if planted on the square, it is only necessary to divide this number by the product of the distances in feet that the trees are to be planted. For example, it is desired to plant pears 20 x 20 feet on the square. The product of these distances is 400, and 43,560 divided by 400 gives 108, the number of trees per acre. If the hexagonal system of planting is used instead, and the same distance is desired, there will be 124 trees to the acre, or an increase of 15 per cent.

## CHAPTER VI.

## SOILS AND THEIR PREPARATION FOR PLANTING.

The pear is one of the hardiest fruit trees and flourishes on many types of soil and occasionally under conditions which no other trees would stand. The exceedingly fertile valley soils along the river bottoms of the North Central Interior Region are well adapted for pear culture. Trees on such soils make a very rapid and thrifty growth, and bear regularly and heavily with a minimum amount of fertilizing. Much of this bottom land soil is subject to periodical flooding during the winter season, and the pear is the only fruit tree that will thrive under the excessive moisture conditions that sometimes exist. Fig. 111 shows



FIG. 111. Bartlett pear orchard on low land where the trees stand in water for weeks during the rainy season. In the center of the picture may be seen indistinctly a post left near the top of the tree by receding high water.

an orchard in Tehama County which is planted on low land that floods during the rainy season. When the picture was taken the trees were 25 years old and were standing in water from 1 to 3 feet deep. They were blooming and leafing out under this seemingly unfavorable condition, which exists for weeks at a time. The orchard is said to be productive, seldom failing to yield a good crop. There are many orchards of this kind along the Sacramento River, and as long as the under drainage is good, allowing the soil to dry out quickly after water is removed from the surface, there is little danger of the trees being injured. On the other hand a heavy clay subsoil or hardpan, tending to keep the water in the upper strata of soil too long, will cause injury to the trees.

The red granitic soils, such as those in the foothill sections of El Dorado, Placer and Nevada counties, are found to be quite well adapted to the growing of pears. While the trees do not as a rule make as satisfactory a growth as they do in the valley, the fruit is highly colored and of excellent quality. Pears grown in these sections are not ready to market until those from the lower elevations of the Sacramento and other valleys are practically gone. This late maturity practically insures a good market and prices obtained are generally well above the average for the state. The depth of the soil very largely determines the size that the trees attain, and on hillsides where it is shallow they are always smaller than in low lands where there is a greater depth. Cover crops and heavy fertilization with barnyard manure, and occasionally commercial fertilizers, improve the size of the trees on the type of soil found in the mountainous sections. In Lake County there is quite a variety of soils adapted to pear growing, and some very large trees are produced in Scotts Valley and Big Valley close to the lake, the quality and color of pears being similar to those of the foothill sections along the Sierras. This soil varies from a fairly light sandy loam along the streams to a rather heavy clay, which has a tendency to bake and become very dry. The same may be said of Mendocino, Sonoma and Napa counties.



FIG. 112. Large Bartlett pear trees in Lake County.

Many excellent pears may be found growing in the Santa Clara Valley on a great variety of soils varying from light clay loam to heavy black, sticky clay. In contrast to this latter type of soil we find the light, gravelly soil of the Mojave Desert in Los Angeles and San Bernardino counties growing good pear trees.

While the pear will thrive under some conditions that other fruit trees will not stand, and will grow fairly well wherever deciduous trees of any kind will grow, it should not be planted on very shallow soil which is better adapted to peaches and plums. If the soil has a depth of 3 feet or over they may be expected to thrive, and other conditions being favorable will bring the owner good returns. Quite frequently the man who is contemplating setting out pear or other trees bases his judgment as to what they will do under his conditions, on an analysis of the soil.

While theoretically the amount of plant food present in a soil should be a safe guide, in actual practice it has not always indicated true possibilities and many a man has been led astray by soil analysis. Such analysis will show how much food material there is in the soil, but will not show how much is available, and the only test is to plant the trees and note results. Charles B. Lipman states as follows regarding soil analysis:\*

“This idea comes down to us from the days of Liebig, who with many others believed that analysis of soils and analysis of plants by prevalent methods would, by giving us a cue to amounts of minerals found in soils and in plants respectively indicate what minerals and in what quantities they should be returned to the soil to maintain fertility. While this kind of an idea appears logical enough, superficially, more careful reflection and numerous experiments prove it to be, if not erroneous, at least of little practical value. To be sure, in soils which are totally deficient in plant foods, like the leached sands and peats of the Atlantic coast and elsewhere, chemical analyses indicate in general that fertilizer applications are necessary. But in the large number of soils which do not belong to that class, and especially in those deep soils of this state which are so well supplied with large quantities of the plant food elements, ordinary chemical analysis of soils can not be used as a criterion to fertilizer needs.”

Thus, while it is well to know the proportion of the elements of plant food in a soil, conclusions as to how the trees will grow should not be drawn from this information alone. In cases where there is a marked scarcity of certain of the elements of plant food a soil analysis is sometimes valuable in revealing this fact, and in pointing toward a solution by the use of proper fertilizers.

#### PREPARATION FOR PLANTING.

Hastiness in planting trees in an orchard before the land has been rightly prepared has many times been the cause for regret in later years. Run down grain lands that have grown crops of wheat and barley for twenty-five years or more, while they may grow fairly good trees, are not to be compared to virgin or alfalfa soils. There is no better crop to grow on land prior to setting out an orchard than alfalfa, and many fine orchards testifying to this fact may be found in the state. If it is desired to set trees on land that has been in grain for years, or that has been recently cleared of native vegetation, two or three years in alfalfa will greatly improve its condition by the addition of nitrogen and humus, as well as physically, and the trees will respond quickly when planted. As alfalfa will not thrive without more moisture than comes from the normal rainfall in most parts of the state and as even in sections of abundant rains there is liable to be insufficient moisture in the summer time, irrigation is necessary in order that the foregoing plan may be carried out.

\*“Some Common Misconceptions with Respect to Soils and Soil Fertility.” The Monthly Bulletin, California State Commission of Horticulture, Vol. IV, Nos. 5 and 6, p. 231.

The amount of time spent in leveling the tract for planting will depend much on whether or not irrigation is to be practiced. There are a few successful pear growing sections in the state where the trees are grown without irrigation. In such sections if it is expected that trees will never be irrigated it would not be necessary to spend as much time in grading, although a certain amount is always desirable. If there is even a possibility of irrigating at some later time this work should never be neglected. In the case of land to be irrigated too much care can not be exercised in grading so that water may be carried through the orchard without difficulty from the main ditches or pipe lines. Difficulty is often experienced in the case of new land set to trees, especially if such land has never been irrigated. Settling may take place here and there throughout an orchard which will prove a great disadvantage when water is applied later. To avoid difficulty of this nature new land should be thoroughly flooded before trees are set, and then leveled afterwards.

The physical condition of the soil should receive much attention. Orchards set on lumpy, poorly worked soil can not be expected to do their best. The trees will make the most satisfactory growth when the soil is worked as though it were to be put into wheat or other grain crop requiring a fine seed-bed. Deep plowing, especially where a plowsole or hardpan exists is necessary, and even the subsoil plow may be used to advantage. The feeding roots of trees are fine and delicate and can not be expected to perform their normal functions to the best advantage unless the soil is loose and the individual particles fine.

#### MARKING AND DIGGING HOLES.

After the ground has been plowed, leveled and put in the best possible condition, the tract to be planted is marked off prior to digging the holes for the trees. Sometimes this work is done with a plow, the ploughman driving to stakes set in line of the rows to be planted in two directions at right angles to each other. Instead of staking out each row a marker may be attached to the beam of the plow. This marker traces the line of the next row to be plowed parallel to the one being made. The points of intersection of the furrows mark the places for the trees, and holes are dug at these points throughout the field. Instead of the plow being used in this work the entire tract may be staked off by means of a transit or level, or by sighting to stakes set on boundaries of the field and on one or more rows between. This method requires a great deal of care and an accurate eye. Small, fairly level tracts can be quite easily and accurately marked by this method. There are various devices used for measuring and finding the corners which are more or less familiar to orchardists, and a detailed description is not necessary here. Every one, in setting out an orchard, should take a pride in getting the rows straight, as the value is greatly enhanced from an aesthetic point of view, if the alignment is perfect.

#### DYNAMITING HOLES.

The use of dynamite in loosening the soil to a considerable depth where trees are to be planted is now very general. A special grade is made for orchard work, and the amount used in each hole

will have to be determined by trial and will depend on the kind of soil to be treated. From one-half to one stick of 25 per cent strength dynamite, exploded from two to three feet below the surface, is effective in the majority of our soils. The work of dynamiting must be done, in heavier soils at least, when there is a minimum amount of moisture present, or else the soil may be packed and the object for which the dynamite was used may be defeated. A liberal charge in the bottom of holes being dug will loosen the soil sufficiently deep so that drainage conditions will be greatly benefited. On some of the California soils where a hardpan exists within two or three feet of the surface, or where soils are abnormally hard, dynamiting is a necessity and should never be neglected. On the other hand our river bottom soils, with their looser texture, greater depth, and perfect underdrainage do not require the use of dynamite.



## CHAPTER VII.

## SETTING AND CARING FOR THE YOUNG TREES.

A tree that does not start well shortly after being set and fails to make a satisfactory growth during the first season is liable to be stunted always, hence the necessity for the greatest care in making every condition as favorable as possible for the young tree that has been recently planted in the orchard. There should always be plenty of loose soil in the bottom of the hole before the tree is put in. This should be finely pulverized, and preferably from near the surface.

If the weather is hot and dry during planting time the trees must be well protected to prevent the roots from drying out. In order to do this, they may be covered with dampened sacks or stood in a barrel partly filled with water, while being transported throughout the orchard. All injured portions of roots should be removed as well as all those that are misshaped and generally undesirable. It must be remembered that the tree is not dependent so much upon the number of roots that it has as on their character. Four or five thrifty roots which do not crowd each other are preferable to a greater number that run criss-cross and interfere.

The depth of planting should be a trifle greater than the trees stood in the nursery. The whole subject of planting is so ably covered by Mr. A. L. Wisker in his "Planting Suggestions to Orchardists" that we quote from him. While his trees are situated in a foothill section the directions given may in general be followed elsewhere.

## HOW TO PLANT.

"In the average loose soil of the foothills, plant the tree so that it will stand two or three inches deeper than in the nursery. Usually this will cover the point where the bud was inserted. Budded trees are frequently curved at this point, and the curve should always be set so the two o'clock sun (the hottest of the day) will shine against and not into the curved part. Many trees are lost from sun-scald every year through neglect of this precaution. In windy locations, the trunk should be inclined a little toward the prevailing wind. Spread the roots in their natural positions, avoiding doubling them, and cover with the best soil available. When sufficiently covered to be protected from possible injury, pack the roots firmly in place by treading with both feet, remembering that the tree can not possibly absorb the plant food in the soil unless the roots are brought into the closest possible contact, and that this part of the work is the most important thing in planting. Fill hole nearly full and again tramp firmly, after which the hole is to be filled so the soil will stand an inch or so above the surface. The top soil must never be packed, and should always be kept loose during the growing season; it is extremely risky to place manure or any of the ordinary fertilizers in the hole with the tree, but old bones or bone meal

are a benefit if placed in the bottom of the hole and covered lightly with soil. If manure is to be had it should be spread in a circle on the surface around the tree, where it serves both as a fertilizer and a mulch to retain moisture. During the first few seasons of the young tree's growth it is an advantage to apply nitrate of soda to the soil, unless the land is known to be rich. For the first application four to six ounces will be the right quantity. This should be spread on the surface in a circle about eight inches from the tree when the young leaves are about the size of a man's thumbnail, and while considerable rain is yet to be expected. This fertilizer is soluble and will be carried to the roots by the rains. It is as caustic as lye, and must not be permitted to come in contact with the tree or great injury will result. Unless the soil is impoverished, nitrate will hardly be required beyond the second year, except in the case of some tree that is lagging behind. Too much nitrate stimulates rank, soft, sappy growth and is undesirable, while late applications keep the tree active too late in the season. To apply nitrate after the spring rains are over is throwing your money away."

#### WATERING THE YOUNG TREE.

In order that the root system of a newly set tree may become established quickly, and perform the functions of growth necessary to life, it must not be allowed to get dry, and the soil at all times should have a plentiful supply of moisture. While this moisture must not be excessive for any length of time, the newly planted tree is better off for a good soaking. If planted in furrows the irrigation water may be run through these furrows, thus coming in direct contact with the trees. By filling in the furrows immediately after watering and cultivating the surface as soon as it becomes dry enough to do so, the moisture will be retained much longer than where the furrows are left open, and there will be no baking of the surface of the soil which is always objectionable. After the first watering the soil should be kept as uniformly moist as possible by applications of irrigation water when needed, or by frequent cultivation to conserve the supply already present.

#### TREE PROTECTORS.

Immediately after being set in the orchard the young pear trees should have their trunks protected by means of yucca, stiff paper, or other protectors, of which there are a number of different kinds on the market. These will prevent sun-scald and the so-called sun borers which usually accompany it, and in addition will keep the rabbits from gnawing the bark and girdling the trees.

Black colored protectors should not be used as there is sometimes severe scalding in hot sections because of the absorption of the sun's rays on account of the color. Such injury to pear trees has never been called to the writer's attention, but in one instance a young olive orchard with black paper protectors about the trunks was observed,

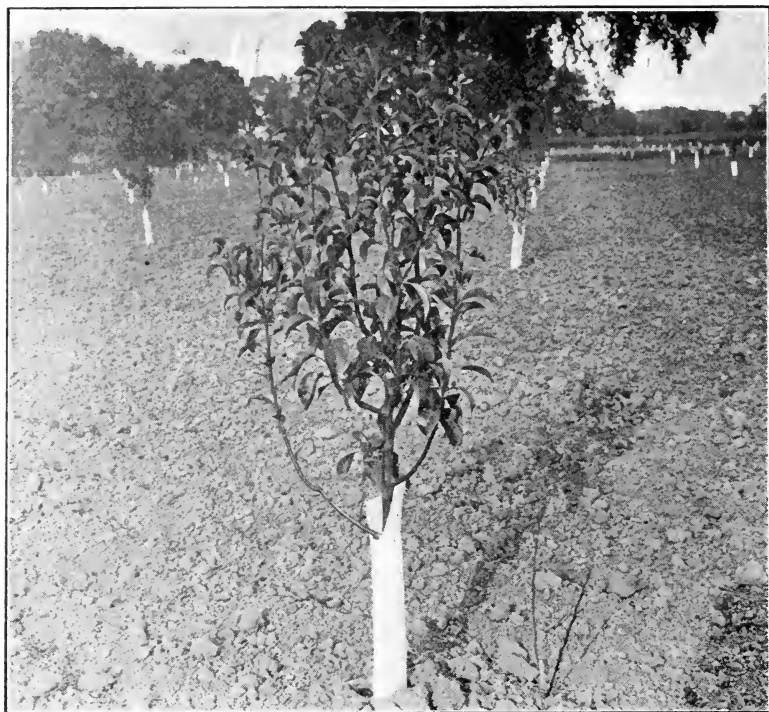


FIG. 113. Yucca tree protectors on young pear trees to prevent sun scald and injury from rabbits.

and many trees were injured by scalding on the south side underneath the paper. This injury was noted in a hot section shortly after an exceedingly hot spell in the summer. No doubt similar injury would result to pears under like conditions. The danger would be greatly minimized in sections of the state that are not subject to excessive conditions of heat during the summer time. Whitewash applied with a brush to the trunks is a valuable sun-scald preventive, and has much value in repelling the attack of rabbits, if combined with aloes. It is, however, very difficult to make a whitewash sufficiently adhesive during the rainy season to remain long on the trees.

Sun-scald may be prevented by a stake, board or other object driven into the ground on the south side of a tree, and in sections where rabbits are not troublesome this method is often used by the orchardists. If rabbits and not sun-scald have to be considered a cylinder of a small mesh of woven wire, placed around the trees, can be used very successfully. Poultry netting of 1-inch mesh made of No. 20 galvanized wire, is recommended.

In sections where snowstorms occur in winter, and the ground is apt to be covered with the snow for days at a time, there is great danger of scalding from the sun's rays reflected from the snow. Trees in all such sections should be protected by any of the methods for preventing sun-scald, that have been mentioned.

## CHAPTER VIII.

## PRUNING.

## FIRST SEASON.

The young trees, whether one or two years of age, should always be pruned when set in the orchard. If one year old they will have few, if any, branches. In cases where there are none it is only necessary to cut back the top to a height of about 20 inches, depending upon the desired height of head. Two-year-old trees may have all the branches removed at planting, or they may have from three to five left as a framework

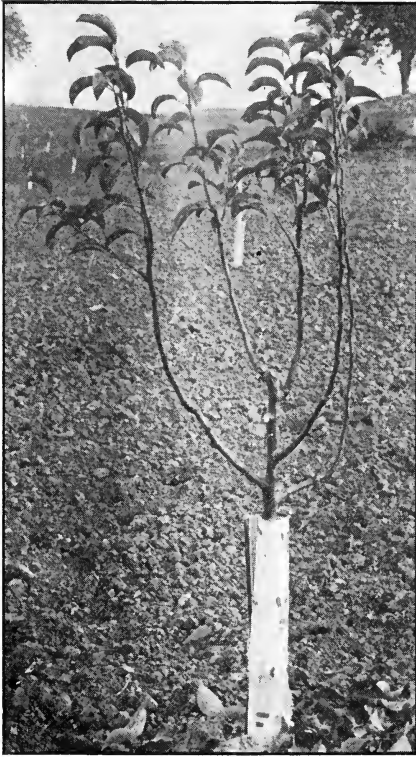


FIG. 114. Pear tree which has been summer pruned. Note the splendid placement of branches.



FIG. 115. Extreme type of upright growth in young Bartlett pear.

for the future tree. As a rule it is best to remove all branches and start with a whip which under all ordinary conditions will develop sufficient branches so that a desirable framework may be selected at the beginning of the second season if not before. This brings up the matter of summer pruning during the first season. From work of this nature that has been seen in various places it has been concluded that the summer season

offers the best opportunity for developing a favorable type of head, and the opinion is expressed that we have only begun to know the value of summer pruning, and as time goes on more and more of it will be done. There are two main advantages to be gained by summer cutting of the tree the first season. In the first place the upright growing tendency can be very largely overcome and a system of laterals developed which will give the tree a good spread. Secondly all surplus branches can be removed and the growth of the most desirable branches for the framework can be encouraged. Fig. 114 shows a summer-pruned tree in the Rio Linda section of Sacramento County. Note the wonderful spread of branches, the uniform size and the proper spacing along the trunk. These trees were pruned under the direction of Mr. Fred C. Brosius County Horticultural Commissioner, Sacramento. The work was done



FIG. 116. Correct number of branches to form the framework but poorly placed, making bad crotches.

during the month of July after the growth had attained considerable length. A foot or more was frequently removed, and from 6 to 12 inches left. Care was taken to cut just above an outside bud in every case where it was desired to increase the spread of the branches. Careful attention to this little detail will mean much toward securing the best type of head for the Bartlett variety, in fact all varieties except a few that are exceptional in that they have a natural tendency to spread. In Fig. 115 the extreme type of upright tree is shown. Summer pruning will correct this fault better than dormant pruning.

**SECOND SEASON.**

The beginning of the second season should find the trees with a sufficient number of lateral branches to form the scaffold or framework. In cases where summer pruning has been carefully done there should be somewhere near the proper number of branches to start with. This number should be not less than three nor more than five. The latter is the favorite number with most orchardists, however, just as large and just as good a tree can be builded with a framework of three branches as with five. The mean between these two figures is often chosen and many orchards are started with four scaffold branches. A certain amount of cutting back will again be necessary at the beginning of the second season while trees are still dormant. This amount will depend

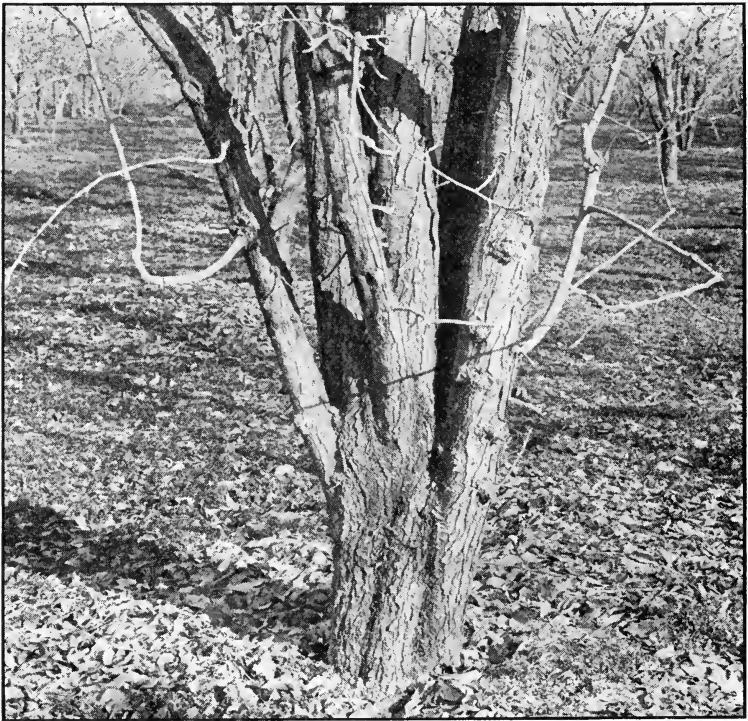


FIG. 117. Too many branches forming the framework.

largely upon the summer pruning. If this work was successful in checking a rank growth very little cutting back may be necessary. If it was done too early, or for some other reason failed to bring the desired results, or no summer pruning was practiced, it may be necessary to cut away considerable wood. Each scaffold branch should be left at least 10 or 12 inches long, the rest of the growth being sacrificed as superfluous. This heavy cutting back tends toward stockiness, which is much to be preferred to slender, willow-like growth.

## THIRD SEASON.

In most cases the three or more scaffold branches that were left at the beginning of the second season will have developed several laterals and the third season it is necessary to select such of these as will be necessary to add another suitable story to the framework. From two to three main branches emanating from each of the scaffold limbs, well placed to balance the head, are desirable. These should form a symmetrical top capable of bearing the maximum amount of fruit. As with practically all of our fruit trees, the open type head is best as it allows plenty of sunlight to enter and abundant room for the branches to develop



FIG. 118. Rank and upright tendency of growth of Bartlett, yet a good supply of laterals. (Photo by D. W. Pitts.)



FIG. 119. Same tree as the one shown in Fig. 118, after removing the central upright branches. (Photo by D. W. Pitts.)

without crowding. Interfering branches or any that are liable to interfere during the season's growth should be removed. Cutting back to keep the tree from attaining too great a height is always necessary. From the third season on, great care should be exercised in cutting out branches that are liable, if left, to need removal a few years later. Cutting away big branches is always attendant with dangers, and the pruner who studies his trees with the idea of preventing crowding of branches in later years so that heavy pruning will be unnecessary is the most successful man in his work.

Summer pruning is desirable during the third season's growth as well as during the two previous seasons. The upright growing tendency of varieties of pears, such as the Bartlett, requires vigilance if it is overcome, and nothing will contribute more to the success of spreading the head than intelligent, careful cutting during the summer time.

#### FOURTH AND FIFTH SEASONS.

The instructions given for pruning during the first, second and third seasons of growth are designed to develop a tree with strong scaffold branches, thrifty growth, well-balanced head, and wide-spreading branches possessing sufficient stockiness to hold up a load of fruit without danger of breakage and without need of propping. The fourth and



FIG. 120. Well-pruned Bartlett pear tree. Fruit on trees of this character can be easily sprayed and easily picked.

fifth seasons' pruning should be done with the idea of maintaining all these desirable characteristics. It will again be necessary to remove many small, interfering branches, and shortening or heading back should be continued. This should not be carried to the extreme and practically all shortening of branches should be confined to the cutting of one-year-old growth. Upright branches will frequently have to be sacrificed for laterals chosen to develop the spreading type of head. Cutting should be carefully done, and except where cuts are made in one-year-old branches it is best to cut close to a branch in order that there may be no stubs and no wounds that will not heal quickly. Summer pruning during the fourth and fifth seasons' growth will have a tendency to force the development of fruit spurs. This is desirable in



the case of varieties that do not possess a heavy-bearing tendency, and may be practiced with all varieties to possible advantage, at least with no resultant injury. About the fifth season pear blight very often makes its appearance. A most careful watch must be kept for this disease at all times when pruning is being done. If any cases are discovered the treatment outlined in the chapter on Pear Blight becomes necessary.

#### MATURE TREES.

The pruning of mature trees is not at all difficult if the first five years' work has been done intelligently and well. The tree enters the sixth year with a good shape, and later prunings are done to keep the head open, to prevent the tree from getting too high, to develop fruiting wood, to facilitate spraying and picking, and to remove blighted and dead wood. On account of the blight the idea of developing fruit spurs from the trunk and low down on larger limbs has been discouraged.

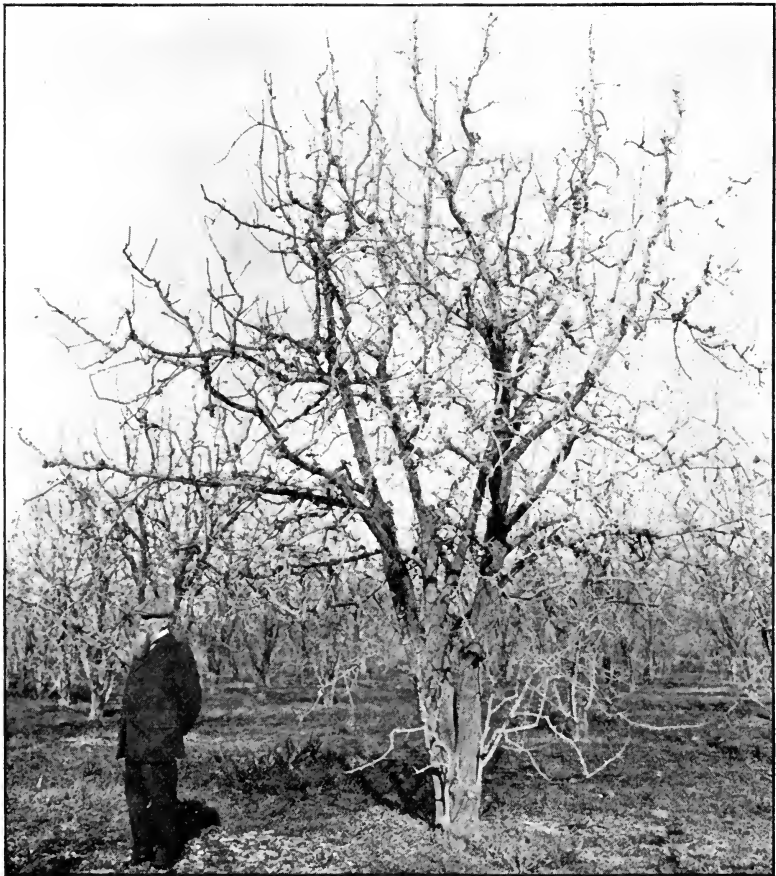


FIG. 121. Redeveloping fruiting wood low down on the trunks of trees which have at one time been stripped.

There are so many cases of blossom infection and the killing of fruiting twigs that it is argued that the fruit should be allowed to grow on the smaller branches, remote from the trunk and larger limbs, in order that the chances of blight getting into the big wood may be reduced to a minimum. In other words the trees are stripped clean from the ground to some distance above the crotches and no spurs are allowed to grow except on the smaller branches. While this reasoning is sound, a few of the better pear growers are allowing new wood to develop from trunks and larger branches which at one time were stripped, with the idea of increasing the production of the trees. Fig. 121 illustrates this point. It is very doubtful if this method is safe enough to be recommended generally and while there is no question about the increased productivity of the trees which are allowed to develop these lower branches, it is doubtful if the increase in pears will be sufficient to pay for the extra work necessary in cutting out blight, for it is sure to get into the trunks when it would not get started were it not for smaller infected branches developing the disease and leading it in. However, the danger is minimized in orchards where a continual, systematic and intelligent fight is being made against this disease, and it is probable that there are growers who can make their trees pay more by the method outlined. In the case of the inexperienced grower or the grower who fights blight occasionally or when he is forced to do so, no chances of this kind should be taken. Generally speaking any growth from below the crotches should be removed in pruning, including the water sprouts or suckers that come from the seedling root below the crown. Also any succulent growth emanating from the larger limbs for some distance above the crotches should be removed unless such growth may be made to serve a useful purpose.

The practice of cutting out water sprouts each season, regardless of whether or not anything else in the way of pruning is attempted can not always be recommended. Water sprouts are only branches that have made a very rapid growth without the development of laterals or even thrifty buds. If left in the tree the second season's growth may be very slight and they will develop into branches having the same fruit-bearing possibilities as any other branches of the tree. Cutting them back to lengths of a foot or less has a tendency to cause the development of fruit spurs close in to the trunk. If this cutting back is done during the summer season the tendency is increased, and in some orchards such pruning is desirable.

Heading back small branches from the ends to prevent too long a growth should be practiced. Propping becomes necessary when this important part of the pruning operation is neglected. Short, stocky branches, well supplied with fruit spurs are the most desirable. A knowledge of the fruit-bearing habits of a tree is necessary to intelligent and most successful pruning. The pear bears most of its fruit on short spurs (see Fig. 122), which live year after year, producing each season with little growth, but always forming new buds for another crop. The pruning away of spurs may be practiced for the purpose of thinning a crop, but oftener it is necessary to encourage their development. The fruit buds of such spurs may be distinguished from the leaf buds because

of their plump, more or less roundish appearance, the leaf buds being more pointed and more slender.

The intelligent pruner will study the growth of his trees carefully, noting the varying habits of the different varieties, and will prune according to the needs of each variety as grown under the conditions existing in his orchard. Only a few general rules can be laid down in regard to pruning, and these can be modified to conform to all conditions. Specific instructions can not be intelligently given on paper and it is necessary for each orchardist to determine the needs of his trees and act accordingly.



FIG. 122. Fruiting spurs on Bartlett pear tree.

#### TREATMENT OF WOUNDS.

Small wounds that result from cutting young growth do not need any treatment except when pruning is done to remove pear blight as explained in chapter on that disease. In the case of wounds following the removal of large branches it is important that healing should take place promptly and that the wounds should be completely covered by a new growth of bark at the earliest possible date. There are various wood rots due to fungi which often cause trouble. While the pear is not as subject to wood-rot troubles as other deciduous fruit trees, in order that as few chances as possible may be taken, there should be no stubs left in pruning. Cuts should be made parallel and close up to the branch from which another branch has been removed. It is obvious that as wood rot is due to fungi, disinfection of wounds is very important. The common practice in the past has been to treat pruning wounds with common lead paint, or in late years with C or D grade asphaltum.

Some very careful experiments have been conducted at Watsonville by W. H. Volck, County Horticultural Commissioner of Santa Cruz County,\* which show that in the case of the apple these materials, instead of protecting the cuts against wood rot, make conditions ideal for the development of the fungus (*Polystictus* sp.). Treating of this subject of wound protection against wood rot in the article referred to in the footnote, Mr. Volck stated as follows: "Formerly such treatment

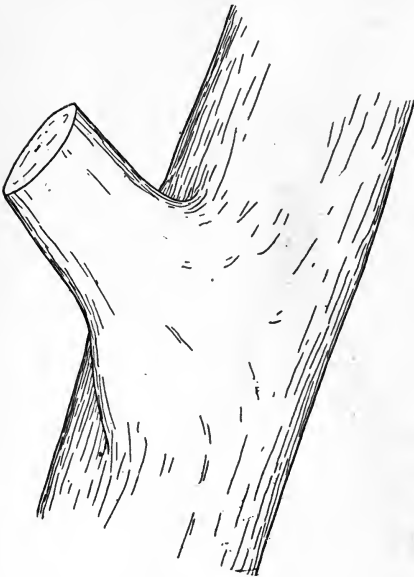


FIG. 123. Undesirable stub left in pruning.

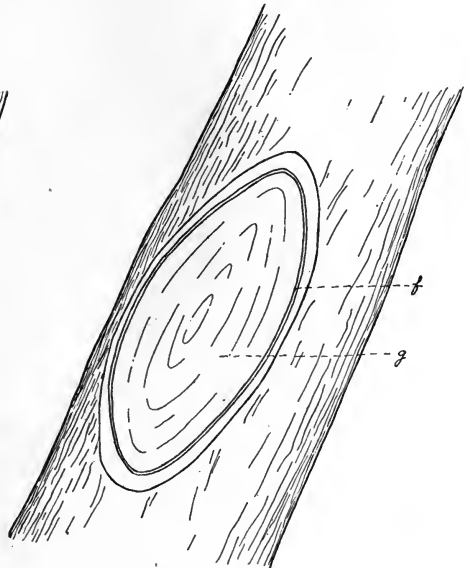


FIG. 123a. Desirable cut made in removing stub shown in Fig. 123. (After W. H. Volck.)

consisted in the application of some kind of paint to the entire surface of the cut. This painting appeared to be the proper thing in that the cut could be sealed, thus presumably protecting it from infection. In this it failed, however, owing to the fact that the sap pressure behind the painted surface is nearly always sufficient to rupture it. At the same time the paint retains enough of the sap to keep the wood saturated and provides an excellent medium for the growth of wood-rot fungus. It so happens that the most impervious paints have proved to be the poorest protection against wood-rot infection." The method of treatment that has proven satisfactory in Mr. Volck's experiment is outlined briefly as follows: First of all the cut must be made properly, as no amount of treatment will prevent the rotting of a stub. The smooth close-in cut, as soon as it is made, is covered over on the edge or bark layer with a thick coating of asphaltum-paraffine grafting wax, to prevent the drying out of the cut surface, and the dying of the bark, giving it a chance to begin the healing process immediately. Most of the wood is left uncovered, and driven full of copper nails or tacks which are

\*W. H. Volck—Article Monthly Bulletin, State Commission of Horticulture, Vol. VI, Nos. 3 and 4, "Pruning Fruit Trees with Special Reference to the Apple."

left in the wood permanently, and which disinfect the wound as they gradually go into solution. After treatment of the outside portions of the cut with the asphaltum-paraffine mixture<sup>1</sup> and the insertion of the nails into the wood, the entire surface of the cut is covered with Bordeaux whitewash.<sup>2</sup> In addition to the use of copper nails a copper screen was tacked over the wood of the cut. This is recom-

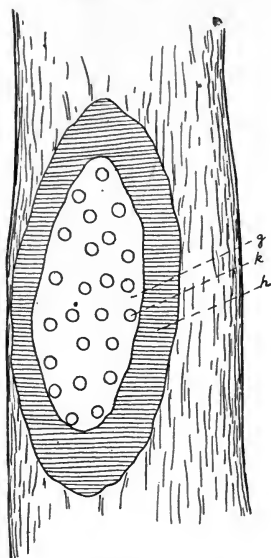


FIG. 124. The same cut shown in Fig. 123, with the bark layer covered with a thick coating of asphaltum. The exposed surface of the cut has been driven full of copper nails or tacks. (After W. H. Volck.)

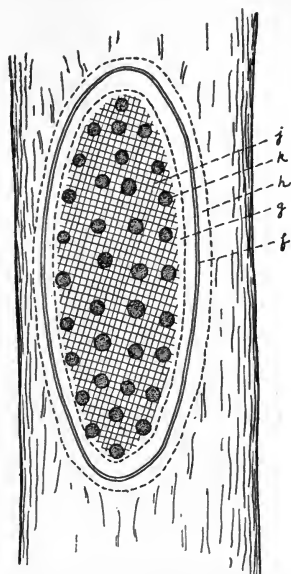


FIG. 125. Same as Fig. 124, with the additional feature of a copper wire screen as further protection against rot fungi. (After W. H. Volck.)

mended as a supplementary treatment and in the case of large cuts becomes almost a necessity.

While Mr. Volck's experiments were conducted with apple trees, the principles involved in pruning apples are the same as in the case of all other trees, and his treatment which has been so satisfactory in the apple orchards will, without doubt, be satisfactory with all other fruit trees that are subject to wood rot from infections in pruning wounds. The fact can not be over emphasized that no treatment of the end of a stub, an inch or more in length, left by careless pruners, can be of any value whatever, and the treatment outlined is to be used only in cases of properly-made cuts. Many an orchard is ruined beyond recovery by careless pruning. There can be no healing of stubs without the return flow of sap from the leaves, and this sap when on its downward course can not reach the ends of stubs that have been left, consequently there will be no healing; drying out will

<sup>1</sup>Asphaltum-paraffine grafting wax is composed of (D) grade asphaltum and paraffine wax at the rate of 8 parts of asphaltum to 2 parts of paraffine by weight. These ingredients are melted together until thoroughly mixed.

<sup>2</sup>Bordeaux whitewash used by Mr. Volck was made by thinning commercial Bordeaux paste with suitable quantities of water.

take place and finally wood-rot fungi will gain entrance and cause decay. It is true that pear trees will stand more abuse in pruning than any other kind of deciduous trees. Nevertheless the same general principles apply to all and despite the hardiness and ability of the pear to recuperate after an injury, the same care necessary with other trees will pay when given to the pear.

An illustration of the amount of abuse the pear may undergo and still produce good crops of fruit may be seen in Fig 126. At one time



FIG. 126. Bartlett pear tree, the heart of which has rotted and been removed some years after pear blight control work.

this tree had a bad attack of blight making it necessary to remove practically all of the bark from one side of the trunk. Despite the fact that paint was used over the entire injured surface, in seven years' time decay had destroyed the exposed wood and after it was removed there remained nothing but a shell of the original tree. Even the roots on one side were cut away so that from a height of about five feet above the ground to the crown the heart of the tree was chiseled away and most of the root system on the same side was sacrificed. Despite this fact the tree is still living, and annually produces a good crop of fruit that pays well for the effort and expense that were necessary to save it.

#### PRUNING TOOLS.

The best general purpose pruning tool is a small hand shears. In pruning young trees up to the age of five years there is little need for anything else providing the work has been well done each season and there are no heavy branches to be removed. A larger, stronger, two-handed shears is sometimes used. This type of shears is awkward to handle and is not generally used, but has a place in the pruning

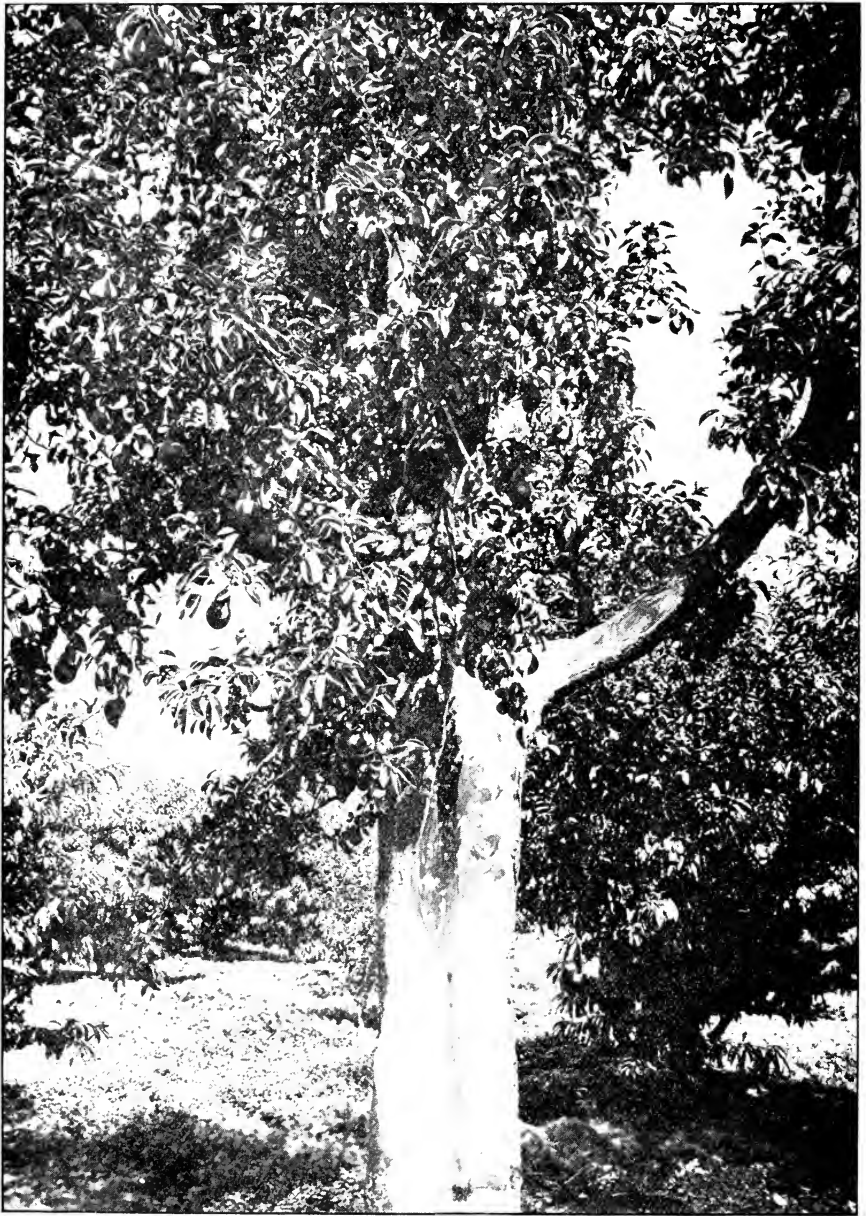


FIG. 127. The same tree shown in Fig. 126, photographed at close range. Indistinctly the heavy crop of fruit which it is still capable of producing may be seen.

equipment as it is valuable in quickly removing branches of considerable size; however, in every case a saw will serve the purpose practically or just as well, and many orchardists depend upon the use of the small hand shears and a saw.

In blight work other types of tools are needed. Some of these are shown in the chapter on blight. Another type of pruning shears or hook sometimes used consists of a movable cutting blade set at an angle in a hook in the end of a long handle (eight feet or more). The blade is operated by means of a hand lever connected with the blade by a metal rod running along the side of the handle. In pruning shade trees this type of shears has its place. In the orchard it can not be recommended. It is especially undesirable in the case of pear trees on account of the blight and the necessity for making each cut with care and knowing whether or not blight is present in the branch removed, and if present whether or not it has all been removed. This is not always possible when working at long range.



## CHAPTER IX.

IRRIGATION, CULTIVATION, COVER CROPS, FERTILIZERS,  
INTERCROPS.

In an arid summer climate such as that of California irrigation is desirable in every case where conditions are not such that there is a natural subirrigation. The pear orchards of the Sacramento River section, which at one time were not watered because it was not thought necessary, are practically all irrigated now, with splendid results. Without irrigation these orchards will produce, but neither the trees nor the pears will attain the size and quality that they do with irrigation. Fig. 128 shows the general method of pumping the water from the Sacramento River for irrigation of pears. This picture was taken on the E. A. Gammon place at Hood. Mr. Gammon, who at one time



FIG. 128. Centrifugal pump and discharge pipe which carries water from the Sacramento River over a levee into a pear orchard.

grew pears without irrigation, can now testify to its value, and a great increase in crops because of the installation of a pump and irrigation system.

## METHODS.

The water is carried to the orchards in gravity canals, or raised from the river, or wells, by means of centrifugal pumps operated by electric motors. Either the furrow or basin method of irrigation is used. The first method requires a series of parallel ditches, generally about four, between two tree rows. These can be made with a plow, cultivator or small ditching tool. Small heads of water run in such ditches for about

twenty-four hours, the time depending upon the character of the soil, will usually result in a good irrigation. Deep ditches are to be preferred to shallow, especially on heavy soils which are more or less impervious. To prevent washing the furrows are sometimes curved. It is a common practice to run them around the trees thus insuring better wetting of the entire root system.

The basin system is used generally in the large pear growing districts of the Sacramento Valley. This is a flooding system by means of small levees constructed at right angles to each other between the tree rows, forming square or rectangular basins in which the water is allowed to remain for the desired time. On the lighter types of soils, at least, this system is quite satisfactory. In order to prevent baking the cultivator must be used after irrigation by the basin method. This is particularly necessary in the case of heavy soils. If the cultivator is not used, the soil bakes and cracks, the moisture is rapidly lost, and the physical condition of the soil is impaired. No stated time can be given for the application of water. If the supply is plentiful it should be used only when an examination of the soil reveals the need. In some cases irrigation will necessarily have to be done when water is available. In general two or three irrigations throughout the season are desirable.

#### CULTIVATION.

Successful pear growing is accomplished in parts of California without irrigation where it has not been possible to develop a supply of water. The conservation of moisture in such cases is the prime requisite of success. There is nothing else that will conserve the moisture as well as frequent cultivation, whereby the soil is rendered fine on the surface. A dust mulch, five or six inches deep, should be the aim in cultivating such orchards. By using the cultivator once a week or oftener the capillarity of the soil is broken and the moisture thus prevented from reaching the surface and being lost through evaporation. Cultivation, while being necessary in this case, is also desirable in keeping down weeds, which should not be allowed to grow when there is a scarcity of moisture and the trees need all that the ground contains. Too little cultivation is given most of the unirrigated orchards and the loss of moisture and suffering of trees from drought in the fall of the year, which is so evident at certain times, could be prevented by judicious cultivation. The principle involved, while simple, is little understood by many orchardists and there is a prevalent notion that less moisture is lost if there is no cultivation.

#### COVER CROPS.

The subject of cover crops is one of great importance in every orchard community, and the requirements are practically the same for the pear orchard as for all other orchards. In California a fortunate condition exists that does not apply to the other states of the Union. That is, during the winter or rainy season cover crops may be grown in the orchard to good advantage. This is not true in all parts of California but is true in the main pear growing sections, where frequently burr clover grows luxuriantly with little or no attention. Humus

being scarce in soils of all arid sections the cover crop is needed especially to supply this very desirable part of a fertile soil. While a heavy growth of wheat, rye, or barley will, when plowed under, result in the formation of humus, there is nothing more satisfactory than leguminous cover crops.

Failure to grow a satisfactory cover crop is often due to the fact that the seed of *Melilotus indica*, or whatever other crop is used, is sown in the fall in ground that is dry, and a lack of moisture may exist for weeks or months after sowing. It is very important, to prevent a poor crop or an entire loss from drought conditions, to irrigate the land before the cover crop is sown. Whenever irrigation water can be secured its use will abundantly repay the effort and expense of application.

#### LEGUMES.

Since the discovery that plants belonging to the family Leguminosae have the power, through the agency of bacteria occurring in nodules on the roots, of drawing upon the nitrogen of the air and adding it to the soil, all plants belonging to this family have become recognized as being of extreme value as cover crops. This is because of the scarcity of nitrogen in our orchard soils in general. Burr clover, which grows so commonly throughout the northern part of California, is a very satisfactory legume for orchard cover crop purposes. In many places it grows wild and makes a dense crop. Sweet clover (*Melilotus indica*) is used commonly in orchards of southern California and is gradually becoming recognized as one of the best legumes for the north. Another satisfactory legume for the northern



FIG. 129. A good cover crop of hairy vetch, *Vicia villosa*, growing in a Santa Clara Valley orchard.

pear districts is vetch. The two species commonly used are hairy vetch (*Vicia villosa*) and purple vetch (*Vicia atropurpurea*). This plant thrives well under the climatic conditions of the average winter and makes a splendid growth to plow under in the spring. See Fig. 129. It is sown in the fall, preferably before the rainy season begins, and grows throughout the winter. Plowing may be done any time in the early spring when the growth of the plant has become satisfactory.

If cover crops are desired during the summer season their use will depend principally upon the availability of a sufficient supply of water for irrigation. Clovers, vetches, beans and peas of any kind that will do well under the existing conditions may be used. Alfalfa is frequently sowed as a cover crop. Where the supply of irrigation water is great enough to insure against either the trees or the alfalfa becoming too dry there is no better cover crop when not grown too long. Alfalfa being a perennial plant, there is always a tendency to leave it in the orchard too long after planting, cutting it several times each season for hay, to the possible detriment of the trees. There have been some exceptions to this rule and there are orchardists who favor the growing of alfalfa in an orchard year after year. The extremely deep rooting of this plant makes it valuable in improving the physical condition of the soil and bringing up the plant food from a greater depth than the ordinary cover crop root systems reach. Alfalfa allowed to grow in a pear orchard for one season only, if plowed under when there is a maximum amount of green material, is an exceedingly valuable cover crop. If it grows longer than one season plowing is difficult because of the very tough roots and the trees may not do as well because of its presence. When used as a cover crop alfalfa should be drilled between the tree rows, being kept at a distance of at least 3 feet away from the trees. With ordinary precautions where there is plenty of water the use of alfalfa is recommended. Where water is scarce it should never be grown as it requires a large amount of moisture and frequently trees are stunted because of its use as a cover crop under drought conditions.

#### FERTILIZERS.

Under the previous heading the fertilizing value of cover crops, especially the legumes, was briefly discussed. The judicious use of such crops where conditions will permit of their growth will result in good tree growth, and the production of big crops of good fruit without the addition of other fertilizers. It must be remembered, however, that nitrogen is the only essential element of plant food that is added to the soil by plants of the family Leguminosæ. Indirectly they serve another valuable purpose in that they greatly improve the physical condition of the soil and render more available potash and phosphoric acid, which are the other two elements of plant growth that are essential in every soil.

#### BARNYARD MANURE.

The addition of nitrogen may be accomplished through the use of barnyard manure, as well as the growth of leguminous cover crops. In fact, experiments that have been directed by our state experiment

stations, and experience in the use of manure by fruit growers have proven that there is nothing more valuable for the fertilization of the ordinary orchard soils than barnyard manure. The use of the automobile, auto trucks and tractors has limited the supply of horses on our modern farms to such an extent that the supply of manure is much less than ever before and the orchardist who can secure it in any quantity is very fortunate. In some cases it is possible and when available there is nothing that will bring better results.

#### COMMERCIAL FERTILIZERS.

Commercial fertilizers are rapidly assuming a place of great importance in orchard work. Nitrate of soda, bone meal, dried blood, guano, muriate of potash, potassium nitrate and sulphur each possesses merits as a fertilizer. Nitrate of soda is the most commonly used, and without doubt the most satisfactory commercial fertilizer at the present time. In quantities of from 150 to 200 pounds per acre, scattered evenly over the surface or drilled into the soil in the spring, it has considerable value in the pear orchard where the soil is depleted and trees are doing poorly because of a lack of nitrogen. The fertilizer value of sulphur was not recognized until recently when Prof. F. C. Reimer of the Talent Experiment Station in Oregon discovered that when used on alfalfa this element would result in a tremendous increase in production. Previously it had not been considered necessary to plant growth. Its value in the case of alfalfa indicates that it will be beneficial if applied to other plants and while we have no records indicating that it is valuable as an orchard fertilizer its use in the form of gypsum (calcium sulphate) is to be recommended, when the gypsum may, in addition to its value in supplying a requisite amount of lime to the soil, also add sulphur to the benefit of the trees.

#### INTERCROPS.

During the period from the time of planting until the pear trees come into profitable bearing, which is ordinarily seven or eight years, it is often necessary for the owner of an orchard to grow crops between the trees in order to help keep up the expenses of development. There is no real objection that can be made to intercropping provided the soil is good, the proper crops are chosen, and there is sufficient moisture present throughout the season, either normally or from irrigation, so that the trees will not suffer. An orchard when planted represents a permanent investment which is to last during a lifetime or longer. Hence the trees should always receive the first consideration. With these facts in mind intercrops of beans or peas, tomatoes, cantaloupes, corn, potatoes or other vegetables, or strawberries, can be grown at a good profit. Beans or peas are mentioned first because they are legumes and instead of depleting the soil they may have a beneficial effect in the addition of nitrogen. Annual crops are to be preferred to perennial crops in the young orchard. Alfalfa is sometimes grown and cut for hay. This practice can not be recommended, for unless the water supply for irrigation is abundant there is usually a condition of drought such as to interfere seriously with the best development of the trees. Young pear orchards have been seen in the Sacramento Valley with the foliage yel-

low, the growth sparse and a generally unhealthy condition in mid-summer because of alfalfa growing between the rows. Corn is another crop often planted in the young orchard. Its use can not be safely recommended except in rotation with other crops. In the first place it is a heavy nitrogen feeder, consequently is hard on the soil; secondly, it grows to such a height that the trees are shaded too much, especially when corn is planted during the first three seasons of their growth in



FIG. 130. Intercrop of field corn in young pear orchard.



FIG. 131. Intercrop of beans which produced 31 sacks per acre grown between the trees of young Bartlett pear orchard.



FIG. 132. Same orchard shown in Fig. 131, three years later. Note the size that pear trees have attained, indicating that no harm has been done by growing intercrops each season.



FIG. 133. Intercrop of tomatoes growing between trees in young Bartlett pear orchard.

the orchard. Fig. 130 is a picture of a young pear orchard in the Rio Linda section of Sacramento County which illustrates this point.

On the extremely fertile soils along the Sacramento River in Sacramento County pear growers have made a great success of beans, tomatoes and cantaloupes as intercroppings. Fig. 131 illustrates the possibilities of success with beans, and Fig. 133 shows a fine crop of tomatoes growing in a young pear orchard. The field of beans yielded 31 sacks per acre. This exceptionally high yield was partially due, no doubt, to the fact that inoculated seed was used. From 15 to 18 sacks per acre is probably about the average that could be expected from beans in a young orchard. Fig. 132 is a picture of the same orchard shown in Fig. 131, taken three years later. At this time eleven hundred trees produced 1,300 boxes of pears. It will be noted that the trees have made a splendid growth despite the fact that intercroppings of beans and tomatoes have been grown each season and that the returns from these crops have paid good interest while the orchard was coming into bearing. A rotation of beans, tomatoes, corn and cantaloupes is practiced by the Sacramento River pear growers who are intercropping their young orchards. The success which they are making of such crops as those mentioned is, of course, only possible where the soil is good and where moisture conditions are favorable as in this section.



## CHAPTER X.

## GRAFTING THE PEAR.

Pear trees are not difficult to graft, and in cases where an undesirable variety is growing in an orchard it may be easily changed to one that is desirable. The principal thing to bear in mind in grafting pears, as well as other deciduous fruits, is that a quick-growing, large variety should not be chosen for topworking on a smaller slow-

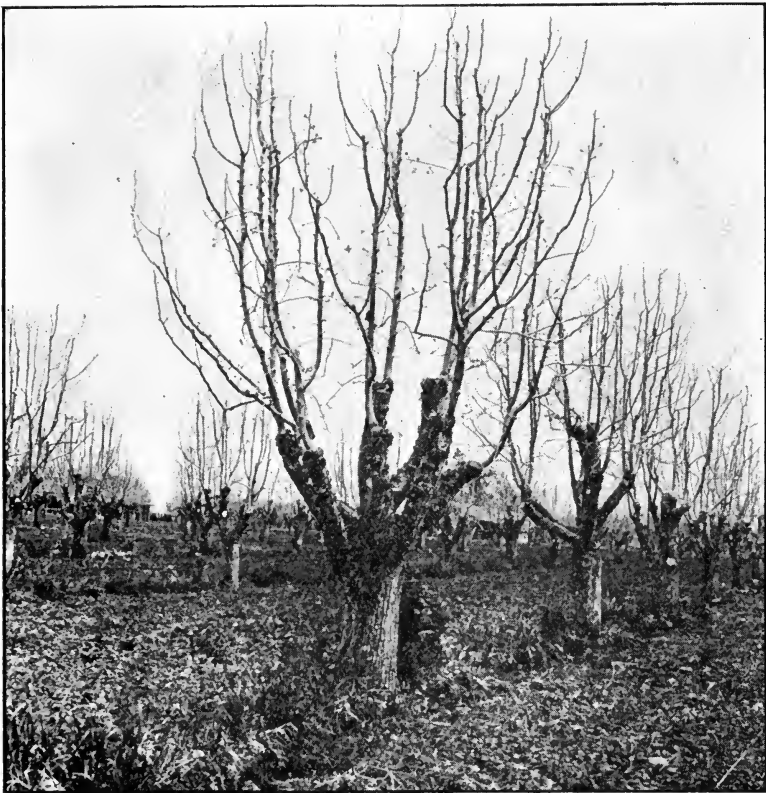


FIG. 134. Bartlett graft on Easter Beurre stock. A splendid union has taken place and a very satisfactory growth of the scions.

growing variety. For example, the Easter Beurre or the Beurre Hardy varieties would not be suitable for grafting on the smaller, slower-growing Bartlett. On the other hand the Bartlett does particularly well when grafted on stock of these varieties. Fig 134 shows some grafts consisting of Bartlett tops and Easter Beurre trunks. In this case the union is perfect and the growth of the Bartlett tops is all that could be desired. Fig. 135 shows Easter Beurre grafts on Winter Nelis in the same orchard. Again the union was perfect and the very large, thrifty-growing trees testify to the success of the operation.

### PREPARATION OF TREES FOR GRAFTING.

Smaller limbs are more easily and more successfully grafted than those that are larger. When it is decided to graft a tree over to some other variety, a suitable number of branches from two to four inches in diameter are chosen, and cut off low down near the point where the first set of framework branches emanate from the main trunk. Care should be used in sawing off the branches to prevent splitting as a



Fig. 135. Large Easter Beurre grafts on Winter Nelis stock. This tree was not grafted until 40 years old.

smooth cut is conducive to healing after grafts have been inserted. Sometimes the entire top is cut from the tree at once. This should be done in the case of younger trees, one to five years of age, but in the case of older bearing trees the elimination of the entire top at once may be too great a shock, consequently some of the branches are left until the grafts have made a good growth, when they are removed.

### METHODS.

The common type of graft is known as a cleft graft. In this method the stub to be grafted is split through the center with a chisel or special grafting tool. If the branch is large, *e. g.*, 4 inches in diameter, it will be necessary to split it twice at right angles so that four scions instead of two can be inserted. Still larger branches may require additional splitting. The scion should be cut from a healthy, heavy-producing tree of the desired variety. It must be one-year-old wood selected because of its thrifty habits of growth and large, strong buds. Water-sprout growth should never be chosen for grafting purposes. Neither should scions be cut from trees that have never borne and whose characters of production have consequently never been determined. After scions of the right kind have been selected they are cut in lengths of about four inches, or such lengths as will contain two or three buds. The large end of the scion to be inserted in the split

end of the stub is cut at an angle, leaving a strip of bark on one side with a good bud about the point where the sloping cut begins. This wedge-shaped piece is placed in one end of the split, in the stub, which is held open by means of a wedge, so that the cambium or inner bark of the scion crosses the cambium or inner bark of the stub. The place where the two cross forms a point of contact where union between the cambium or growing layer of scion and stock begins. The grafts are usually sloped outward slightly so that the contact will be sure, although an inward slope will serve the purpose equally as well. One such scion is placed in the end of each split of a large stub, or four scions in all. In the case of smaller branches only one or two scions may be necessary. It must be borne in mind that the healing of the stub is dependent upon the supply of plant food made available by the leaves of the graft, and there must be sufficient grafts to supply an abundance of sap so that the entire circumference of the stub may heal. Too frequently one or two scions are used where the case would require four or more, and while the grafts live, drying out and decay of the portions of the stub remote from the grafts takes place, and eventually the tree is ruined.

#### WAXING.

Grafting wax\* is used to cover the outer end of the scion unless it terminates in a bud. Also the end of the stub including the split portions of the side throughout their entire length are covered with a heavy coating of wax, so that the air is excluded from the cracks containing the scions. This is the most important operation in connection with grafting older trees and waxing should be done with the greatest of care. Sometimes linen cloth is dipped in melted grafting wax, and wound snugly about the end of the stub. The novice can usually get better results by using the cloth than without.

The principle of all grafting is the same. A modification of the method described differs from it in that the end of the stub left after the removal of a branch is not split but a V-shaped piece of a suitable size is sawed from the place where the scion is to be inserted and the cut carefully smoothed with a sharp knife. The end of the scion is trimmed in the same shape and made to fit snugly in the cut portion of the stub. Care is again necessary to have the cambium layers come in contact with each other. This method is more generally used by expert grafters than the cleft method. The beginner will perhaps have better results with the latter. Waxing is just as important with one method as the other.

#### OTHER METHODS.

While the two methods described are generally used there are other ways of inserting scions or buds so that they will grow successfully. Budding, as described in chapter on "Trees, Stocks and Propagation," may be done in the case of older trees providing younger branches are selected for the insertion of the buds. Bark grafting, which is similar to budding except that short scions instead of buds are used, is sometimes practiced.

\*The common formula is 4 lbs. resin, 2 lbs. beeswax, 1 lb. mutton tallow. The wax is prepared by heating these ingredients and is applied usually by means of a brush; thus it must be kept liquid by placing on a small orchard heater or oil stove.

## CHAPTER XI.

## FROST INJURY AND FROST PROTECTION.

Except in isolated districts the pear industry of California has suffered little from killing frosts in the spring of the year, and except at the higher altitudes little uneasiness is felt. Occasionally in the



FIG. 136. Bartlett pears deformed by freezing in the spring.

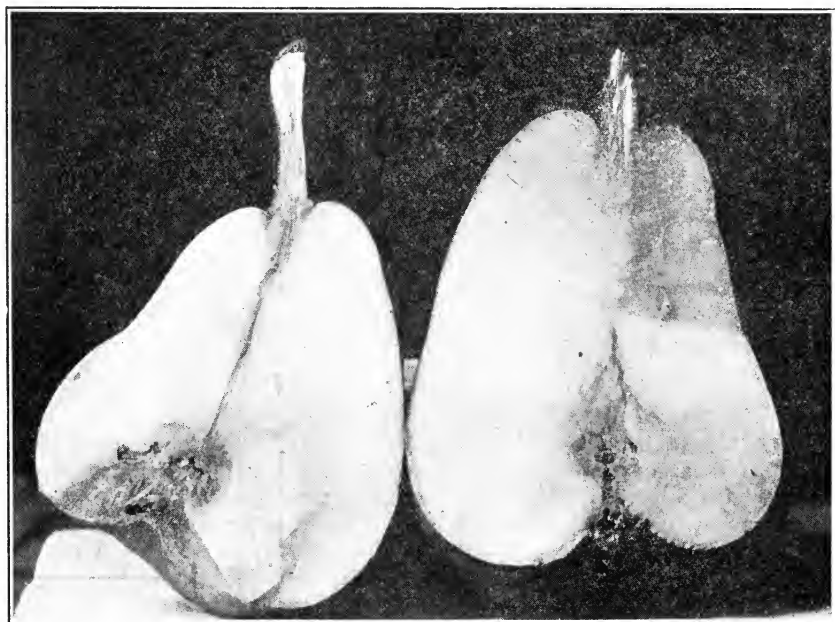


FIG. 137. One of the pears shown in Fig. 136 cut open, showing the absence of seeds due to frost injury.

foothills of the Sierras, snowstorms come late in the season and sometimes, being accompanied by frost, are dreaded by the growers who have orchards in those sections. The pear, being somewhat late in blooming, and being more resistant to frost than any other deciduous trees not excepting the apple, very often escapes when other trees suffer.

Somewhat characteristic frost injury is shown in Figs. 136, 137 and 138. Sometimes a common form of injury, which consists of a heavy

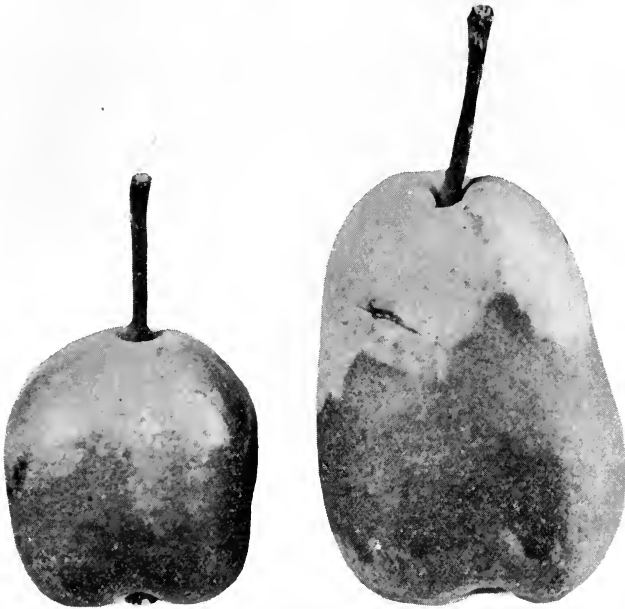


FIG. 138. Russeting of pears caused by freezing in the spring.

brown russeting, affects the calyx end only and at other times it assumes the form of a very characteristic band around the fruit at the point of greatest diameter. Various distortions result from severe injury and frequently the fruit that was affected by frost in the earliest stages of its growth is seedless. Frost-injured pears are never high grade and sometimes are of such poor quality that they are scarcely fit for packing in any grade.

#### FROST PROTECTION.

Location is one of the important factors in frost prevention. There are localities in frost-subjected areas where crops are destroyed with considerable regularity, while in other locations nearby they are seldom injured. The question of air drainage and slope enter into this problem. Orchards on lower lands are generally more subject to frost injury, while a northern slope may be colder than a southern. Bodies of water have an appreciable influence on frost and the presence of water, even when used for irrigation, may prevent the destruction of a crop of fruit.

In sections where frosts occur quite regularly in the spring to the serious detriment of fruit growing, orchard heaters or fire pots may

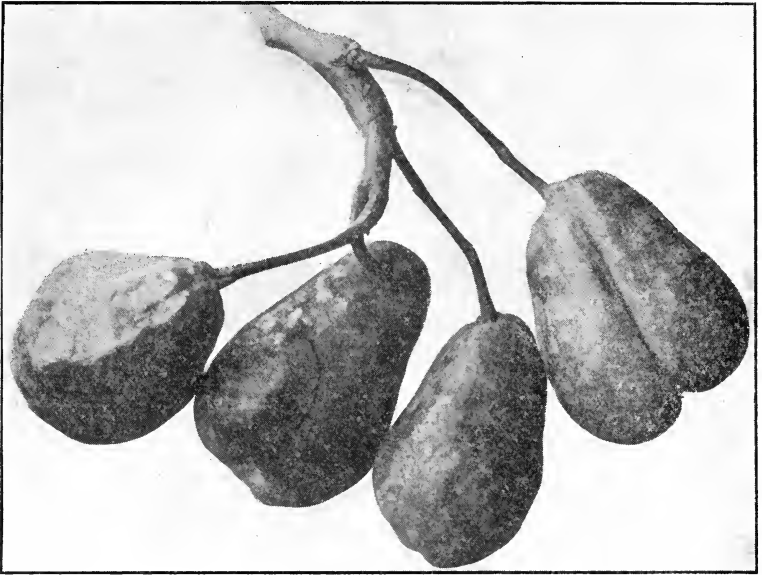


FIG. 133. Pears which have developed from delayed bloom, which frequently follows severe spring frosts.

be used to good advantage. Fuel and equipment are very expensive and the pear grower is not justified in going to the expense of equipping his orchard with heaters except in cases such as that first mentioned. There are a number of different types of heaters, most of which are made for burning oil. One ordinary type is shown in



FIG. 140. Orchard heaters among Bartlett pear trees in "Sierra Nevada Mountain and Foothill Region."

Fig. 140. This picture was taken in a pear orchard in one of the colder locations in El Dorado County. It will be noted that the pots were placed midway between the tree rows in the center of each rectangle formed by four trees. Usually in addition a double row of pots is placed just outside of the border rows in order that they may receive ample protection, which is made more difficult because of the open exposure.

Success in the orchard heating work is dependent upon the care that the various operations receive. In the first place the heaters should be filled and placed in the orchard in plenty of time before the frost period arrives, as the placement and filling of pots at the last minute is not conducive to the best results. The heaters must be lighted before the temperature reaches a point where the fruit will be killed. For example, if thirty degrees Fahrenheit will kill buds the heaters should be burning when the thermometer has reached thirty-four or thirty-two degrees. It is much easier to maintain a certain temperature above freezing than it is to raise the temperature above that point after it has dropped several degrees below. Tested thermometers should be used in orchards where heaters are used. They must be watched during the danger period by careful men who can be depended upon not to fall asleep just at the critical time.

Lighting of the heaters must be done quickly. This is easily accomplished by means of a torch brought over the surface of the oil in heater, upon which a little gasoline is squirted from a specially constructed can. With a little experience men can light the heaters almost without stopping as they pass from one to another. Firing must be continued throughout the entire time that the thermometer registers below the danger point, and also for some little time after it again begins to rise. Sunrise is often a fatal time and it is sometimes necessary to keep the heaters burning for some time after the sun has risen.

## CHAPTER XII.

### SPRAYING THE PEAR.

Without systematic, regular and careful spraying for certain ever-present diseases and insects, success in the pear business is impossible. In the discussion of insect pests and fungous diseases, specific instructions are given for each pest. There are a few general principles regarding spraying which are needed if one expects to get maximum results.

#### WHEN TO SPRAY.

The question of when to spray can not be intelligently decided unless the orchardist has a knowledge of the insects and diseases for which spraying is necessary. In the case of certain pests, for example: codling moth and scab, which are nearly always present, rules that are subject to slight variations can be laid down, for spraying to control these pests must be done with regularity and at approximately the same time each season, at least the applications for these troubles must be made when the trees are in a certain condition of their growth. In the case of certain other pests, for example: red spider, thrips, aphids and scale insects spraying does not need to be done regularly and whether or not the need exists must be determined by the owner of the orchard to be sprayed. Preventive sprays for pests of this nature which require contact insecticides for their control are not usually of any value and the time to spray is determined only by a knowledge of the presence of the pests at a certain time during the season. Thus, while in the case of certain insects and diseases spraying becomes a regular thing at approximately the same time each season, in the case of other pests spraying is done only when conditions justify it. Intelligent spraying means a fairly accurate knowledge of the pests and their habits and a lack of such knowledge often means time and money wasted in making untimely applications.

#### THOROUGHNESS IN SPRAYING.

There is nothing in connection with spraying work in general that needs greater emphasis than the need for thoroughness in applying a spray. Sprays either kill by contact or by poisoning through assimilation after being taken internally. In the first case it becomes exceedingly difficult to apply a spray in a thorough enough manner so that every square inch of surface on a tree is covered. In the case of spraying for sucking insects of all kinds it is absolutely necessary that no portion of a tree be missed. Scale insects and aphids breed very rapidly and failure to kill practically 100 per cent may mean a practical failure in controlling the pest. With these insects present to spray for the work should be done by careful, trustworthy hands who should be taught to exert every effort toward spraying so thoroughly that no insect wherever present on a tree would be missed. Theoretically it would be possible to reach every one, practically it is not, and



despite the most careful work, enough insects will always escape so that the result of spraying will not be complete eradication.

It is hard to get sprayers to realize the difficulty of wetting every square inch of surface of a tree unless they will examine them immediately after making the application, before the spray has had a chance to dry. Then it will be seen that certain portions have been missed because of the spray not having been directed at proper angles to reach them. Too often we find sprayers directing the spray from one side, allowing the wind to carry the mist through the branches with the idea that in doing this they are getting good results. Spraying done from one side of a tree only is never thoroughly done. If the wind is blowing far better results can be attained by spraying against the wind, when not too hard, with a high pressure so that the spray will be blown back upon the opposite side of the trees. The best spraying is done when the sprayer walks entirely around the trees spraying each from every possible angle as he proceeds. The work is greatly facilitated by the use of a forty-five degree angle used as an elbow for the nozzle. This angle enables the sprayer to easily direct the spray upward, downward or any desired angle to the side.

#### QUANTITY OF MATERIAL.

More stress must be laid upon the methods of application and the thoroughness of application than the strength of the insecticide or fungicide used. In the case of most of the sprays careful experimenters have determined the amount that it is necessary to use in order to control the pests for which the spray is designed. Increasing the recommended strength in order that better results may be attained is usually a foolish practice as no strength of material can be effectively used unless it reaches the insects or pests. The man who fails to get results in spraying with a standard mixture and who attempts to make improvement by strengthening the spray in practically every case would accomplish his purpose not in the way attempted, but by using more of the standard strength mixture. In other words, too often failure to get results is due to the use of from three to five gallons of spray per large tree when thoroughness and success would require at least twice this amount.

#### THE PIPING SYSTEM FOR SPRAYING.

On account of wet weather the ground in an orchard is frequently so soft that a spray truck can not be moved about. Such a condition as this has interfered with spraying for scab practically every spring, in some of our orchards. The solution of this problem is found in the piping system of spraying which enables the fruit grower to treat his trees at any time during the season when rain is not falling.

The cost of installing the piping system is quite heavy and is the factor that prevents its general use. After installation the expense of operation is much less than that of the commonly used gasoline-power outfit. Some figures for comparison may be of interest in this connection. Ordinarily, three men are required to operate the gasoline-power sprayer, two nozzle-men and a man to attend to the team, pump and outfit in general. The usual capacity of a tank is 200 gallons. By

working steadily with water handy for filling tanks, 10 tanks, or 2,000 gallons, per day may be applied. It often requires, for thorough work, 10 gallons of spray for every average-sized bearing tree, thus the services of three men are required to spray 200 trees per day, or an average of 66 $\frac{2}{3}$  trees per man. In the E. A. Gammon orchard, which is piped as described later, it is not difficult to force 1,000 gallons of spray per day through each lead of hose. It is stated by Mr. Gammon that 10,400 gallons were applied from 10 leads of hose in one day. To apply the same amount of spray with power sprayers it would require the use of five ordinary machines and at least fifteen men to operate them. Counting on an average of 10 gallons per tree, each man holding a hose in the Gammon system would spray approximately 100 trees on an average per day. If quicker service than this was desired an additional number of hose connections could be provided. The amount of spray applied per tree is often less than 10 gallons and depends very largely on the spray being applied and the pest that it is expected to control.

In order that readers may have as many specific details as possible regarding the piping system of spraying, two systems in use in Sacramento River pear orchards will be described. The first system that was installed, as far as the writer has been able to learn, is that in the Hayward Reed orchard, close to Sacramento, in Yolo County.

#### HAYWARD REED SYSTEM.

Like many others among the pear growers, Mr. Reed experienced great difficulty in getting his orchard sprayed at the right time each spring, because of late rains and wet soil. The dread disease, scab, which requires an early spray for its control, often played havoc with the fruit crop because of the impossibility of spraying at just the right time. Being a man of a progressive nature, Mr. Reed conceived the idea, nine years ago, of laying pipes throughout his orchard through which the spray could be forced from a central pumping plant, and spraying could be done at any time that men could walk among the trees. Since that time he has demonstrated that such a system is practical, efficient and economical in its operation, and as the gasoline-power outfit has superseded the old hand pump so it is safe to predict that in the larger orchards at least the piping system will supersede the gasoline-power outfit.

At present the Reed equipment consists of a "Bean Giant" four-cylinder pump located near the center of his orchard, and run by an electric motor. From the pump a one-inch pipe is laid 18 inches deep, and extending throughout the entire length of the orchard in one direction. Every seven rows apart and at right angles to the main pipe  $\frac{3}{4}$ -inch pipes with service cocks every seventh tree extend in the opposite direction across the orchard. These pipes are laid close in to the tree rows, and are deep enough so that there is no danger of a plow disturbing them. The service pipes for attachment of spray hose are located close to the trees where they do not interfere with plowing. The rows of trees are 17 $\frac{1}{2}$  feet apart and the trees in rows 20 feet. One man only is required to handle each hose and sprays 49 trees from each hose connection.



FIG. 141. Spraying cherry trees at a distance of one-half mile from pump, illustrating the high pressure attained in the Gammon underground spraying system.

#### GAMMON SYSTEM.

Fig. 143 is an accurate map of the underground spraying system in E. A. Gammon's orchard, as it was originally planned. A slight modification of this system was finally adopted and will be explained later. The heavy lines in map indicate the pipe lines extending throughout the 100-acre orchard, and the light lines represent tree rows. The pumping plant is located in the extreme southwestern corner of the picture. A "Bean Giant" four-cylinder pump, Fig. 142 is used to force the spray throughout the system, the power for running the machinery being derived from an electric motor. Water is raised from the river with a  $1\frac{1}{2}$ -inch centrifugal pump through the pipe D into the tank A. The dilute insecticide or fungicide flows by gravity through pipe E into delivery tank B, which is equipped with a powerful agitator that keeps the spray well mixed. From tank B the liquid is pumped into the system at a pressure of 350 pounds at the pump. This pressure is sufficient to give a strong spraying pressure at nozzles at the points farthest away from the pumping plant, as illustrated in Fig. 141, which shows cherry trees being sprayed at a distance of approximately one-half mile from the pump. As the specifications do not show clearly in the cut they are printed underneath. From these it will be seen that the pipe running from the pump to point B is  $1\frac{1}{2}$  inches in diameter. From this point it is reduced to  $1\frac{1}{4}$  inch, later from  $1\frac{1}{4}$  to 1 inch, and  $\frac{3}{4}$  inch at extremities, all service cocks being  $\frac{3}{4}$  inch.

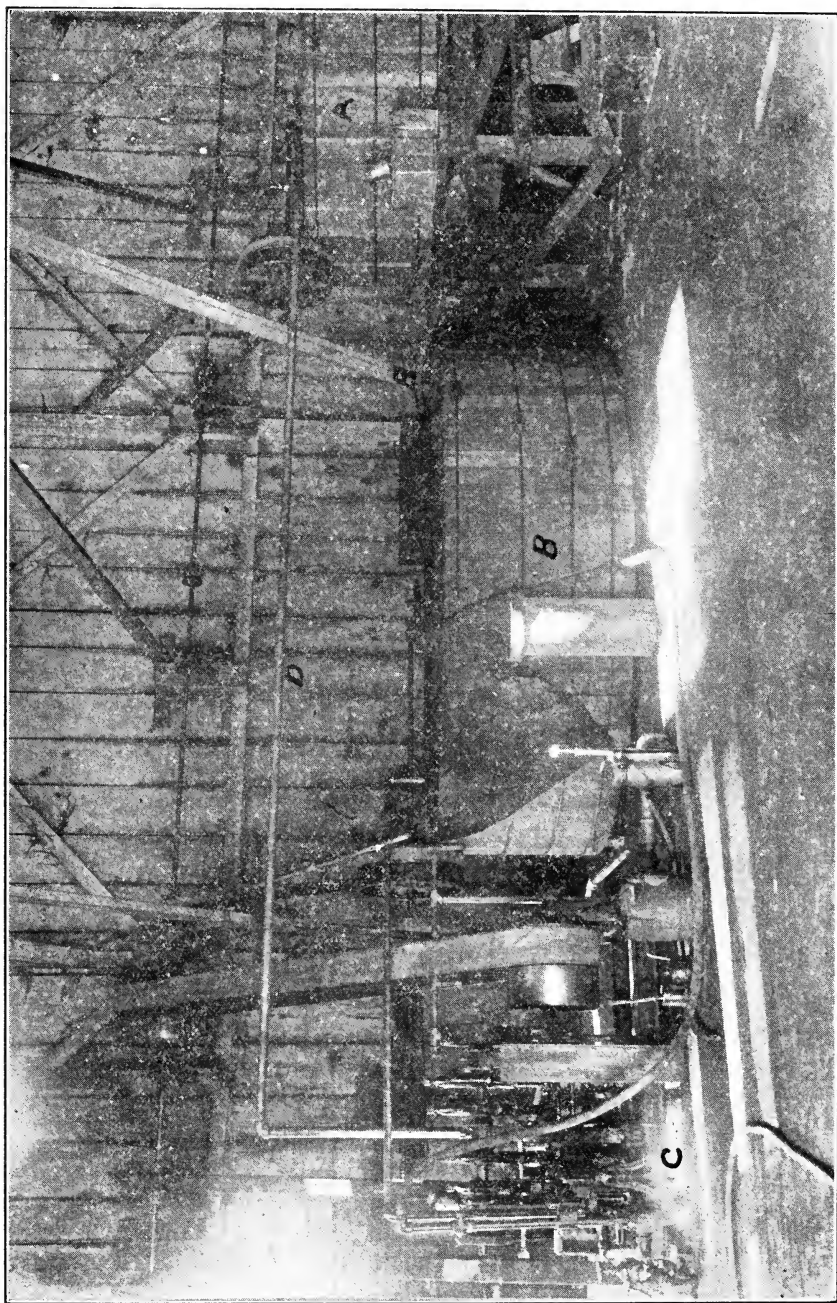


FIG. 142. View of pumping plant and mixing and spraying tank used in underground spraying system in the E. A. Gammon orchard, Hood, California.

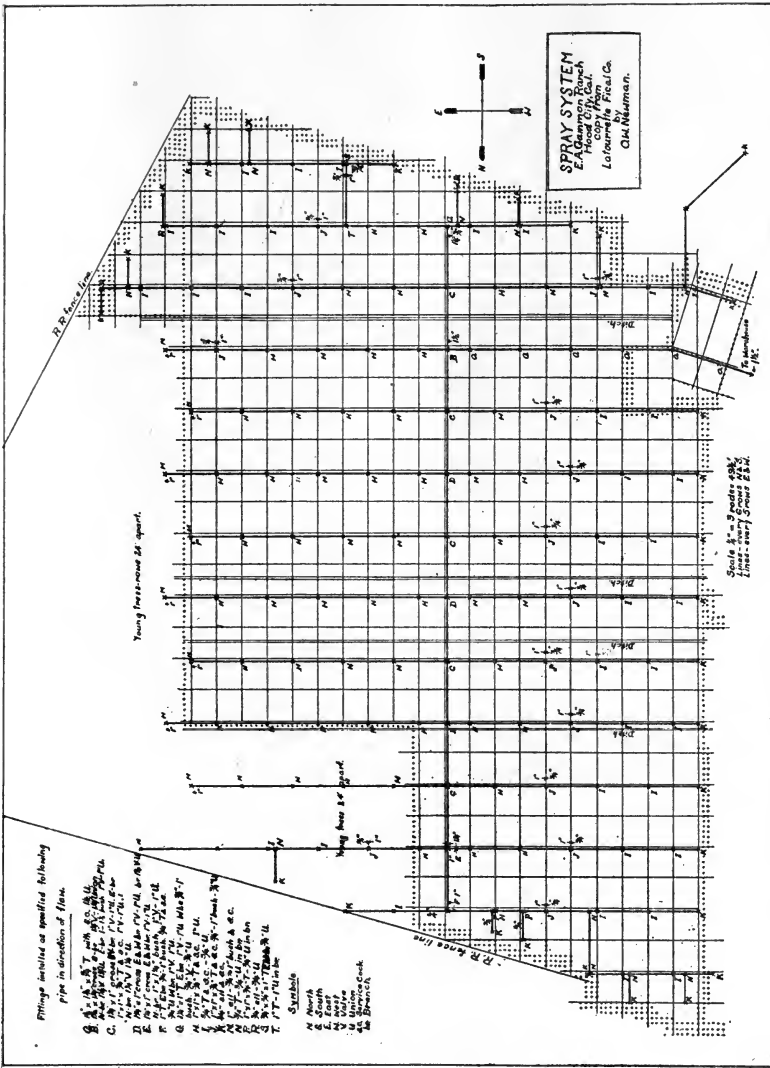


FIG. 143. Map of underground spraying system in the E. A. Gammon orchard, Hood, California. A. 1 1/2" x 1 1/2" x 3/4" T with S.C. 1 1/2" U. B. 1 1/2" x 1 1/2" cross S-br. 1 1/2" V. 1 1/2" U. N-br. 1 1/2" V. 1 1/2" U. E-br. 1 1/2" V. 1 1/2" U. C. 1 1/2" x 1" cross W-br. 1 1/2" V. 1 1/2" U. E-br. 1 1/2" x 3/4" T & S.C. 1 1/2" U. N-br. 1 1/2" V. 1 1/2" U. D. 1 1/2" x 1 1/2" U. N-br. 1 1/2" V. 1 1/2" U. E-br. 1 1/2" V. 1 1/2" U. E. 1 1/2" x 1" cross E. & W br. 1 1/2" U. N-br. 1 1/2" V. 1 1/2" U. F. 1 1/2" x 1 1/2" U. N-br. 1 1/2" V. 1 1/2" U. E-br. 1 1/2" V. 1 1/2" U. G. 1 1/2" x 1 1/2" U. N-br. 1 1/2" V. 1 1/2" U. H. 1 1/2" x 1 1/2" U. N-br. 1 1/2" V. 1 1/2" U. I. 1 1/2" x 1 1/2" U. J. 1 1/2" x 1 1/2" U. T. & S.C. 3/4" U. K. 3/4" U. L. & S. C. M. 1" E11 3/4" to 1" bush. & S.C. N. 3/4" T. 3/4" U. in br. P. 1 1/2" x 1 1/2" T. 3/4" U. in br. R. 3/4" E11 3/4" U. S. 3/4" x 3/4" T. E. W. br. 3/4" U. T. 1" T. 1" U. in br. Symbols—N—North; S—South; E—East; W—West; V—Valve; U—Union; S.O.—Service cock; br.—branch. (Copy by O. W. Newman.)

In the figure it will be seen that the original plan was to have pipes laid every twelve rows in an easterly and westerly direction throughout the orchard, these pipes branching from a main lead in the center of the orchard, extending throughout its length in a northerly and southerly direction from point B in main lead from warehouse. Service cocks were to have been placed every 10 rows. This plan required the use of 125-foot leads of hose, which were found too long for one man to handle. In order that this difficulty might be overcome the pipes were laid 8 rows or 8 rods apart with hose connections every 5 rows, so that 40 trees are now sprayed from each lead, which is only 75 feet and which can be readily handled by one man. The depth of pipes is about 18 inches.

*Cost of Installation*—Mr. Gammon states that the cost of his system, exclusive of the motor, was about \$5,000. This cost may seem prohibitive to some, but when the permanence of the system, the saving in cost of spraying, the saving in time and material, and general efficiency are considered, it is probable that any paying orchard of 50 acres or more will justify the installation. He has pointed out only one difficulty that has been encountered since beginning operations with his plant and that is leakage in the valves, which are rapidly damaged by the grinding of a granular spray forced through the pipes under high pressure.

## CHAPTER XIII.

## BACTERIAL AND FUNGOUS DISEASES OF THE PEAR.

## PEAR BLIGHT.

In 1878 Professor T. J. Burrill of the University of Illinois isolated the organism which causes the disease of pears known as blight, and since that time the various theories that have been advanced by those who were not willing to accept a scientific fact have been disregarded by all horticulturists and plant pathologists. The causal agent was found to be a bacterium and was named *Bacillus amylovorus*.

The plant pathologist can easily isolate this species of bacteria from infected orchard material, and inoculations with pure cultures of the organism, resulting in the development of the disease, have been made over and over again, so that the proof of this particular organism being responsible for the blight in pears, apples and quinces, but rarely in other trees, is just as positive as that which convinces us that tuberculosis, typhoid fever and diphtheria are due to specific bacterial organisms in the human system.

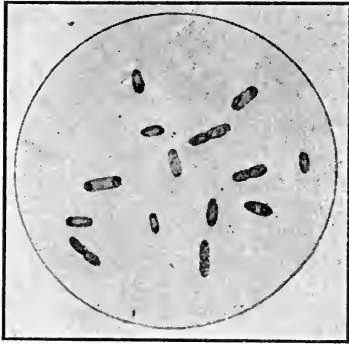


FIG. 144. The organism which causes pear blight, *Bacillus amylovorus*, greatly enlarged. (After U. S. Department of Agriculture.)

## Distribution.

The distribution of pear blight is very wide in this country. Its presence in many localities, otherwise well adapted to the cultivation of the pear, has made it necessary for fruit growers to give up growing this fruit. Perhaps in all cases where failure was met with because of this disease, the adoption of the present careful scientific methods of control which have been evolved because of an exact knowledge of the cause of the disease, would have resulted in successful pear culture. The degree of virulence differs, however, in different places and the problem is much more difficult under conditions that favor its development and the intensity of its attack. In California, this point is illustrated nicely by certain sections where the blight seldom occurs, and where if it does make its appearance during certain periods of time, it is easily controlled. There are other well known sections where the disease is continually present and where it seems to possess a virulence that makes control work not only difficult but a continuous job. There are many factors that enter into the problem, which are responsible for the seriousness or the lack of importance of the disease. Some of these factors are soil, climate, disease carriers and rapidity of growth. Succulent, rapid growing shoots are more susceptible than the hardier slow growing branches

and any factor present which tends to produce a rapid growth and an abundance of water sprouts will favor the disease.

#### Nature of Injury and Spread by Insects.

The symptoms of pear blight are too well known to the average pear grower of California to need description. For the benefit of those growers who have had no experience with this disease and can not detect its presence in the orchard, the following description and illustrations are designed to aid in as clear a manner as possible.

In the first place there should be no confusion between the terms twig blight, fire blight, trunk blight, etc., as these, being due to the same organism, are synonymous, and merely designate the point of attack. Twig blight in the pear, if neglected, will in many cases, find its way into the trunk or larger limbs, thereby causing a similar though more often a local effect. A small twig attacked by the blight is blackened and dies while one side of a larger branch only may show the infection. As infection takes place most frequently in the tender growth, and in a great many cases because of blossom visitation of bees and other insects which carry the bacteria, the fruit spurs are killed. The first sign of blight in the spring of the year is often noticed as the infected blossom spurs begin to die, and if the season is favorable for the progress of the disease, and the insects have had a chance to visit trees with holdover blight, a general breaking out of the disease throughout an orchard may result, and the so-called twig blight, the forerunner of serious trouble in the trunks and roots, manifests itself. Frequently, the infection of tender growth takes place through the inoculation in the feeding punctures of aphids, and a bad attack of any species of this pest on pears is apt to result in a serious spread of pear blight, providing that there are trees in the orchard which have blight when the aphids begin their work. One of the worst cases of wholesale spread of blight in a large orchard, witnessed by the writer, took place during a season when *Aphis gossypii* was present in large numbers and every tree in the orchard shared in its attack. The winged generations of aphids, which with most species are common during the summer time, can readily spread the disease as they fly from blighted to unblighted twigs, feeding upon each in turn.

The fact has already been mentioned that the tips of twigs which are diseased become blackened or brown. In addition to this symptom of the blight little beads of gum harden on the diseased bark. Some of these are shown in Fig. 145. These beads furnish a very characteristic symptom of the blight and are always present during the early season when the disease is active. Later, as it becomes dormant or dies out, they may not be present.

As the cambium layer or growing layer of bark is attacked, the presence of the disease may be detected by a pinkish or brownish discoloration of the cambium before it dies. When the disease is "running" in an orchard this discoloration can frequently be traced for several inches back from where the disease can be detected on the outside of the bark. The dead blossoms, brown leaves and small darkened fruits of blighted twigs hang tenaciously after death, furnishing additional symptoms of the disease in an orchard.



While all the symptoms given are valuable in the detection of pear blight the experts, who are trained for the work of control are able to pick out obscure cases some time before death takes place and before there is a marked discoloration. The first symptoms are wilting of the foliage of a diseased twig, bark slightly discolored or blackened in



FIG. 145. Blighted pear twigs. Note the beads of gum in front of arrow.

spots, an abundant flow of sap which may already have oozed from the twig, and a discolored cambium as described.

Holdover blight either above or below ground may be detected by the presence of dead, more or less sunken, areas of brown and blackened bark. The discoloration of the cambium in such cases may readily be seen extending back for a short distance beyond the dead

areas of bark. During the winter season when holdover blight is present its detection is often very difficult and requires the closest searching. It is also somewhat difficult, in fact sometimes impossible, to tell whether or not certain dead areas are due to blight. The problem of removing all holdover being of such importance, it is not safe to take any chances on leaving any suspicious areas of bark that are found during the dormant season, consequently all doubtful cases should be treated as pear blight.

#### **Destructiveness.**

“It is an ill wind that blows no one good,” is an old, trite saying which finds application in the case of pear blight infection of our orchards, for what has meant destruction of business to many, has meant to others the adoption of proper methods of control, high prices for the fruit, and financial success. That the production of pears has been limited to a remarkable degree by the worst of all pear diseases is a fact well known to every student of the pear industry throughout the nation. Whether or not this has favored the industry in California, we know that despite the blight many of our growers are doing remarkably well. With the tremendous production that would result were the blight eliminated so that every one could grow pears, it is doubtful if prices would be so good and the business on as firm a footing as today, and the California pear grower, who considers that blight is the greatest menace to the industry, may be harboring a friend in disguise. Were the disease impossible to control an entirely different light would be thrown on the situation.

In blighted orchards that have been neglected, the loss of trees will vary according to conditions which may be favorable or unfavorable for its development. Many orchards in California have been destroyed outright in a few years' time. More often the process of destruction is slow and each season a few trees die from the attack. Even in orchards where the greatest care is exercised in an attempt to eradicate blight it is quite common to lose a tree now and then. The destructiveness of this disease under conditions that favor its development can be attested by many a San Joaquin Valley orchardist, who some years ago attempted to grow pears in one of the counties of this valley and who lost everything because of the virulence of the disease under the existing conditions.

#### **Holdover Blight.**

This term is used to designate the stage of the disease which is present in trees during the dormant season and which serves as a starting point for infection during the season of active growth. Holdover cankers are common in any orchard where blight occurs and where nothing has been done toward its eradication, and even in orchards where the greatest of care has been exercised in control work some cankers will escape the eyes of the most careful blight cutters and will remain as a menace to the health and life of the other trees. These cankers may occur on any part of the tree, and often are impossible to detect in large roughened trunks by a casual examination of the tree. The plan, therefore, adopted by up-to-date blight cutters is to

gouge any suspicious portions of the trunks and branches. In this way cankers may be discovered which otherwise would remain, with the possibility of their disseminating the disease during the growing season. The type of gouge used is shown in Fig. 147d. The frequent disinfection of the gouge to prevent inoculations is absolutely necessary.

Not all cases of blighted branches discovered during the dormant season will transmit the disease to other trees because of the fact that the bacteria may die and the disease thus become inactive. Cases of this nature are very commonly found offering excuses for the careless man to neglect his orchard hoping that the blight will die out of its own accord. Again, it is not safe to take chances and whenever a case of holdover is found it should be removed because of the possibility that it is in a live condition and therefore capable of spreading the infection to other branches or other trees.

#### Control.

As early as 1895 Mr. M. B. Waite, who was at that time assistant in the Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture, published an article on the cause and prevention of pear blight in the year book of the Department of Agriculture. In this article Mr. Waite gave much splendid advice which pear growers would do well to follow today. After the pear blight made its appearance in California and threatened to very materially injure the industry in certain parts of the state, the Department of Agriculture came to the aid of our growers and in the year book of 1906 we find a report of the Bureau of Plant Industry, from which we quote as follows:

“The Department has worked out by careful bacteriological investigation, methods of controlling this serious menace to the pear and apple industry. The disastrous attacks of the old eastern pear blight upon the magnificent pear orchards of California have brought into prominence the importance of this work. During the past six years the Department has been engaged in demonstrating on a small scale in certain isolated orchards the practicability of controlling the disease, mainly by the eradication of the blighted portions of the tree and the antiseptic treatment of the wounds. Strenuous efforts are being made by the Department, in cooperation with the State Experiment Station and the state and county horticultural commissioners of California, to assist in applying these methods in saving the California orchards.”

There are two methods that may be used successfully in controlling the blight. The first, or cutting method, has been generally adopted in the past, and since the days when Waite demonstrated that by taking the proper precautions, blight removal would save the trees and orchards, hundreds of orchardists have carried on an effective campaign against the disease. The second method, which is newer but which promises to be by far the most practical and economical is the propagation of trees on roots and trunks that are resistant or immune. Great progress in the work of finding resistant or immune varieties and species has been made by the Southern Oregon Experiment Station, under the immediate direction of F. C. Reimer of Talent, Oregon.

### Cutting Method.

This method consists in the removal of diseased wood from the trees. In order that results may be satisfactory the work must be done with great care, and experienced blight cutters are in demand. The job is not one for the careless or negligent man to attempt, but is one for a specialist.

The first rule to be observed in blight cutting should be: as far as possible remove every case of blight as soon as its presence is detected. Failure to do this may mean the loss of trees and much fruit as well as



FIG. 146. Specially made tool which may be conveniently used in the removal of blighted portions of trees. (Photo by Fred K. Howard.)

endless labor and expense. Already a description has been given of twig blight. Very often twigs will be affected and the disease will die out before reaching any of the larger branches. Because of this fact the cutting of affected twigs is sometimes neglected. Such neglect is fatal and no pear grower can expect to meet with success in controlling this disease who neglects the twig blight. It is true that the disease may be so common in all orchards during certain seasons that much labor and expense will be required to remove it. This does not excuse the orchardist from using every effort to do so, as neglect at this time will

surely mean that at some later date a much greater outlay of money will be necessary, as a general twig infection, if neglected, will result in many trunk and root cases that can not be treated without serious injury to the tree to say nothing of the time and expense needed in the work.

Small blighted twigs may be removed by means of a pair of hand shears or a saw. When blight is running in the spring or summer it is always necessary to cut well back of where the blight can be seen on a twig. No distance can be named that is safe in all cases and the blight cutter must become experienced in the work so that he can detect the presence of blight by the discoloration of the inner bark. Cutters should make a practice of examining a twig after it is removed by cutting the bark from the cut end for an inch or more in order that the



FIG. 147. Ordinary kit of tools used in pear blight eradication work.

blight discoloration, if present, may be detected. When it can be seen in a twig so treated the cut has not been made far enough back and some more of the twig should be removed and the process repeated. In general, no branch should be cut less than six inches back from where there is visible blight and frequently it will be necessary to make the final cut a foot or more from where the disease is detected. Disinfection as described under this heading must never be neglected.

The cutting of twig blight, while it may occasion an immense amount of careful work, usually does not result in the disfigurement and permanent injury to the trees, that comes from the cutting away of larger limbs or the removal of large areas of bark from the trunks. It is often very discouraging for the owner of a fine orchard to be compelled to sacrifice the main portion of certain trees, and in other cases, entire trees. He must not, however, hesitate to do this when the blight is present, so that extreme measures are necessary for its removal. Large branches can very often be saved by the careful removal of blighted portions of the bark. Special tools shown in Figs. 146 and 147 are used for this work and the same precautions that must be observed in cutting away small twigs are necessary in this case. That is, cutting

should not stop with the removal of the blighted bark only, but should be continued well into the healthy bark in order that all the germs may be removed.

The fight against blight is by no means confined to the tops of the trees; in fact, if the roots were not also affected by the disease, its control would be a comparatively easy matter. Blighted roots are common in practically every orchard where blight occurs. It may enter the roots in different ways. Careless plowing, whereby portions of bark are removed from the crowns of the trees, creates a fine starting point for infection. Sprouts allowed to grow from the roots about the crowns blight readily and carry the disease to the roots. Such sprouts are very common in cases where the French root (*Pyrus communis*) is used. Figs. 148 and 149 are good illustrations of crown and root work in blight control. The excavation about this tree was large enough so that a man could very conveniently work within. By means of a small hatchet and bark-scraping tools the bark was removed from most of the crown and from the major portions of some of the larger roots. This work is not only laborious but very expensive and many an orchardist would hesitate about putting in so much time and expending so much money on one tree. The owner of the orchard where these pictures were taken has had much experience in blight control work and he considers that it pays to have a man spend a day or more working on one tree if by doing so he can save it to produce regular crops as they do even when badly mutilated as in the pictures shown.

A constant fight is necessary in some of the larger California pear orchards and men are hired who do nothing else throughout the season except blight control work. Such men should not only have a more or less technical knowledge of the disease, but should also know every detail in connection with the practical phases of eradication or control. Constant work with the disease soon enables one to detect its presence even though it may be inconspicuously located. The need of reliable men who take an interest in their work is apparent, and some of the more progressive pear growers hire experts who supervise the work of blight control.



FIG. 148. View of the crown of same pear tree shown in Fig. 149, taken from another side.

#### Disinfection of Tools and Cuts.

Failure to realize the importance of the disinfection of tools and cuts means at least partial failure in the fight against blight. There must be a recognition of the fact that the disease is due to exceedingly minute bacterial organisms which are easily and surely transferred from one cut to another in the process of removing blighted

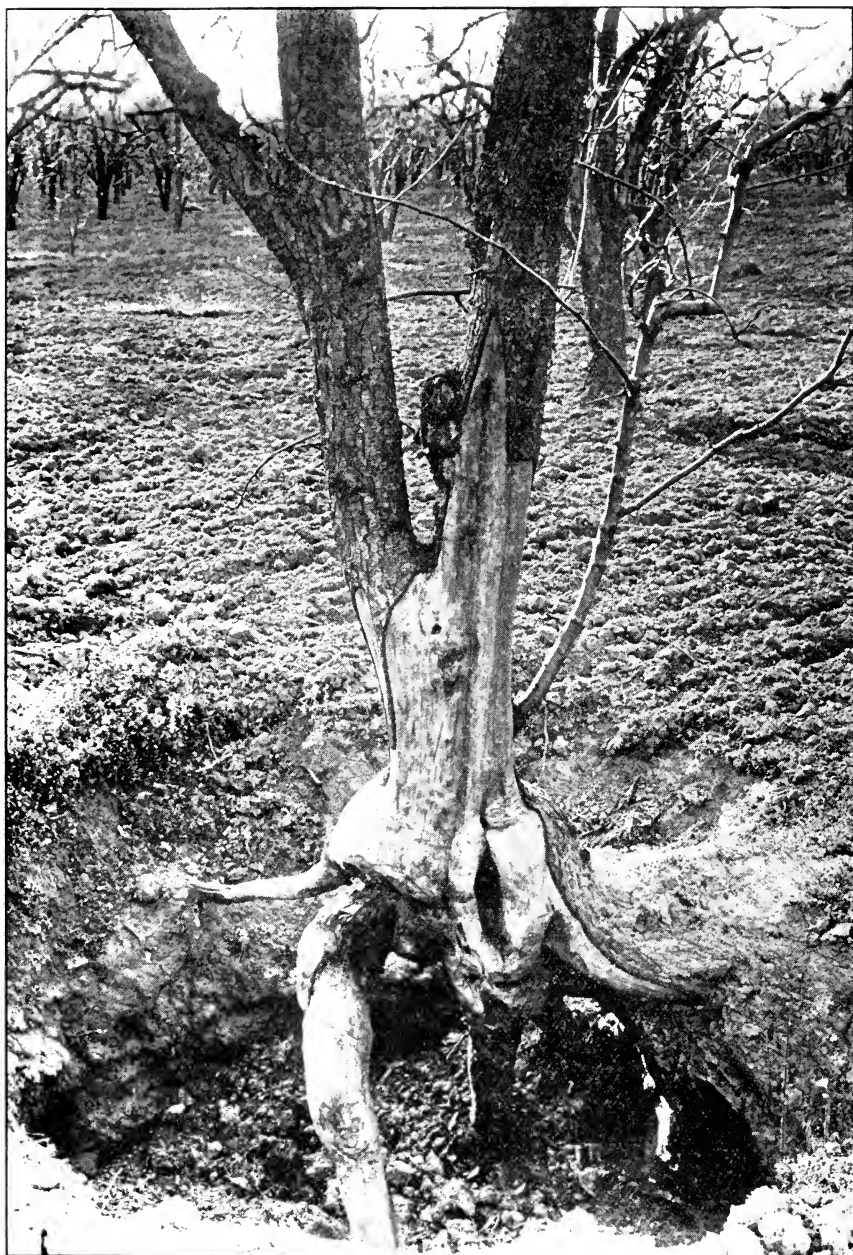


FIG. 149. Severe treatment of a Bartlett pear tree, which was necessary in order that all blighted portions of roots and trunk might be removed.

branches. The surgeon who would perform an amputation without thoroughly disinfecting his instruments before the operation would be considered criminally negligent. While the life of a tree is of much less importance than that of a human being and the same degree of criminal negligence could not be charged against the blight cutter who fails to disinfect his tools, nevertheless he is subjecting the tree to grave dangers comparable to those of the patient of the negligent surgeon.

#### Corrosive Sublimate.

The best all-round disinfectant for this work is corrosive sublimate (bichloride of mercury) in a 1 to 1,000 solution. It is prepared in the form of tablets, one of which dissolved in a pint of warm water gives the desired dilution. The liquid should be carried in bottles or glass jars and not metal containers. Neither should tools be dipped in the liquid as a chemical reaction takes place rendering its use as a disinfectant ineffective. The common method of application is by means of a swab made by wrapping a piece of cloth and securely tying it around the end of a stick. By means of this swab, which may be carried in the liquid, saws, shears and cut surfaces may be quickly treated with the disinfectant. It is well to practice the disinfection of all cuts as well as the disinfection of the tools. This is, of course, very necessary when large areas of bark are being removed from the trunks and larger branches. In such cases it is not important that tools be disinfected until a separate infection is worked on, but it is exceedingly important that the entire surface of such cut surfaces be thoroughly treated with the disinfectant as soon as the bark has been removed.

Corrosive sublimate is very poisonous and the solution should not be left where children might get it, nor where chickens or other animals might take a drink. It will do no injury by external contact with the skin but is exceedingly poisonous when taken internally.

#### RESISTANT ROOTS.

While careful attention to the details outlined regarding the cutting method in pear blight control has resulted in the saving of thousands of trees in California, there are those who have given up the fight and the neglected orchards have either been destroyed or rendered unprofitable. Both those who have carried on the fight successfully and those who have given it up as hopeless will welcome anything which will prevent or render easier the expensive and exceedingly difficult control methods now in use. For some time it has been known that certain species and varieties were more resistant to pear blight than others. For example, the Japanese or Asiatic Pear (*Pyrus serotina*), is not so susceptible as the French or European species (*Pyrus communis*). Most of the older orchards in California have *Pyrus communis* roots and these have been readily affected by the blight. The resistance of the Japanese stock has made it popular of late and whereas practically 100 per cent of the pear trees propagated by California nurserymen four years ago were on European root stock at least 75 per cent are now on Asiatic roots and the effect in lessening the root form of the disease will be very apparent as the new orchards come into bearing. Blight in the tops of susceptible varieties such as



Bartlett, Flemish Beauty, and Forelle, will not be lessened by a resistant root system but with the fight against the disease confined to the portions of trees above ground much of the expense now met with will be eliminated. The Japanese root, while far more resistant than the French, is not entirely immune and the search for something still better is now going on. For taking the initiative in this important investigation, California owes much to her sister state, Oregon, which under the direct and able supervision of F. C. Reimer, has conducted most comprehensive and carefully planned experiments with more than 500 varieties and 30 species of pears at the Southern Oregon Experiment Station

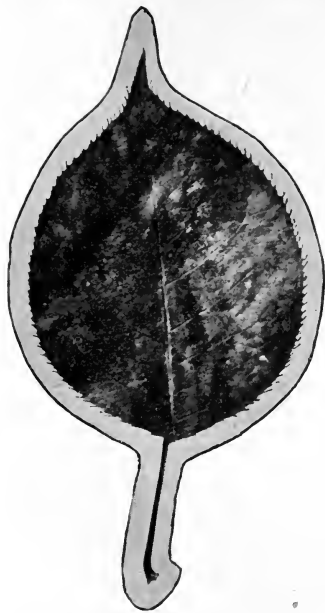


FIG. 150. Leaf of *Pyrus ussuriensis*.

at Talent. It was the writer's privilege to visit at this station recently, where, in the absence of Professor Reimer, Mr. A. C. McCormick described in detail the various experiments. There it has been proven that, under the conditions existing in the Rogue River Valley of Oregon, certain species and varieties are practically immune from blight. In fact, one species upon which 210 inoculations on eight different dates have been made has never developed a single case of blight\* while alongside, susceptible varieties inoculated at the same time with the same cultures have always developed the disease. This species is known as *Pyrus ussuriensis*. Professor Reimer who made a special trip in 1917, to Japan, Korea, Manchuria and China to study this and other Oriental pears, especially the blight resisting types, states regarding it as follows:

"This species appears to be immune to pear blight, at least under the conditions in southern Oregon.

"The season of 1916 has been a favorable one for the development of pear blight. The disease has been unusually severe in many of the orchards, causing the loss of many trees. During the season young vigorous trees of this species have been inoculated 210 times on eight different dates. One hundred and five of these inoculations were made in the tips of young vigorous-growing shoots, 85 in branches less than one year old, and 20 in the trunk of a two-year-old tree.

"Not a single case of blight developed in any of these. Check trees of many of the other species and varieties inoculated at the same time, in the same manner, and with the same lots of bacteria, blighted vigorously. This is the only species which so far has proved immune in our work. It is a native of northern China, Manchuria and eastern Siberia, and withstands lower temperatures than any other known

\*Address by Professor F. C. Reimer before the Pacific Coast Association of Nurserymen.

species of *Pyrus*. In its native habitat the trees attain a very large size, often reaching eighty feet in height and three feet in diameter. Whether this will be a desirable stock for our cultivated American varieties, in the mild climate of the Pacific coast, remains to be determined. We have grafted and budded this successfully on to our cultivated varieties, and have budded our cultivated varieties on to it. However, it will require a number of years to determine conclusively its value as a stock for our cultivated varieties of *Pyrus communis*. If this should make a congenial stock for these varieties it will be very valuable because of its ability to resist blight.

“Unfortunately this species has been confused by some writers with the Chinese Sand Pear, commonly known as *Pyrus sinensis*,\* Lindl. These two species are distinct, and can be easily distinguished. *Pyrus ussuriensis* bears roundish or slightly flattened fruit, which has a short stalk and a persistent calyx; and comparatively short and broad leaves, the margins of which have minute serrations and very long slender bristles. *Pyrus serotina* bears roundish or pear-shaped fruits, with a long stalk, a deciduous calyx and long leaves, with margins coarsely serrate and often bristly. A number of the Japanese nurseries list *Pyrus ussuriensis* but all of these forms which I have seen are simply *Pyrus serotina*.

“Introduction of *Pyrus ussuriensis*. So far as I can determine large trees of this species are rare in this country. Since 1905 it has been sent to this country several times by Mr. F. N. Meyer, Agricultural Explorer of the U. S. Department of Agriculture. Mr. Meyer’s introduction S. P. I. number 21880, is a typical form of this species.

“In the report of the Iowa Horticultural Society for 1912 Mr. Charles G. Patten, of Charles City, Iowa, called attention to a Chinese Sand Pear which he has used in some of his breeding work. He states that in 1880 Mr. O. A. Bardhall, of Grundy Center, Iowa, purchased a tree of the Chinese Sand Pear from John S. Collins & Sons, of New Jersey, which was purported to bear fruit nearly as large as the Flemish Beauty. When it came into bearing the fruit proved small, hard and worthless. Mr. Patten propagated a tree from this because it had proved its great hardiness during the severe Iowa winter of 1883-4. Mr. Patten states that his tree at Charles City, Iowa, has never been injured in the least by cold and has never blighted since it was planted, in 1885.

“Since *Pyrus ussuriensis* has proved so remarkably resistant to blight in our work and as it is the hardiest species of pear known, I thought that possibly Mr. Patten’s tree belonged to this species. In reply to a letter Mr. Patten kindly sent me leaves of his tree, which I received on November 10 of this year. As the tree had not borne this year, no fruit was sent, but Mr. Patten kindly furnished a description of the fruit and stated that the tree probably belonged to *Pyrus serotina*. An examination of the leaves, however, shows conclusively that this tree belongs to *Pyrus ussuriensis*.

“The tree in Iowa is the oldest one in America so far as I have been able to learn. Undoubtedly there are other trees in America just as old

\**Pyrus serotina*.

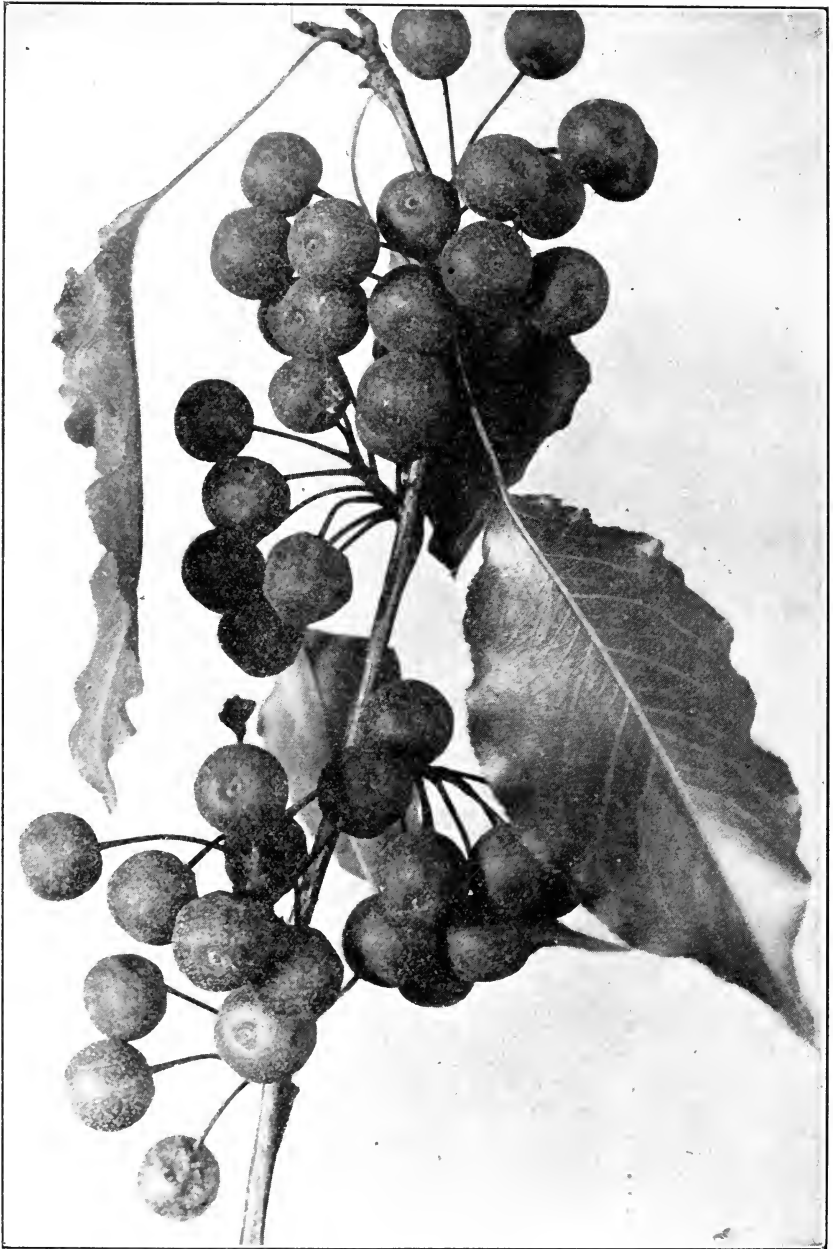


FIG. 151. Fruiting habit of *Pyrus calleryana*. (After Reimer.)

or older than the Iowa tree. It is quite probable that Collins & Sons sent out trees of this species other than the one sent to Iowa. I hope that some of these can be located, and the writer would be pleased to receive specimen leaves and fruits of any tree which promises to belong to this species."

In the same report referred to in footnote the following other species are mentioned as being more promising than *Pyrus serotina*, viz: *Pyrus calleryana*, *Pyrus variolosa* and *Pyrus ovoidea*.

Commenting upon these Reimer states:

"*Pyrus calleryana*, Decne—This species is a native of central and southern China. It bears small, brownish fruit, with a deciduous calyx. The leaves are of medium size, very glossy, and the margins possess short, rounded or dentate teeth. The tree is a clean, vigorous, upright grower, with very smooth bark. This species appears to be adapted to a wide range of conditions, being found at elevations ranging from a few feet above sea-level to an elevation of 5,000 feet. It is often found growing under very adverse soil conditions.

"There are several trees of this species at Oroville, California, which have never shown a trace of blight, while other types of pears near them have suffered heavily from the disease. These trees were grown from seed collected in extreme southern China, and represent the southern type of this species. We have successfully inoculated young, vigorous trees of this type, and in some cases the disease would extend down the branches as



FIG. 152. Leaf of *Pyrus calleryana*.

much as three feet. It appears to be resistant in wood that is two or more years old.

"The type of this species from central China has shown even greater resistance to blight than that from southern China. In this type we have been able to produce the disease only in the young wood; in branches one or more years old all of our inoculations have failed. Since it is very seldom that our commercial varieties on the Pacific coast become infected with blight before they are three years old, this species probably would seldom be affected by blight when used as a stock. Since this species is a native of the mild regions of China, it may prove well suited to the mild climate of the Pacific coast. This species appears to be congenial to our cultivated types, as the scions united readily, and the young trees grow vigorously when grafted on to the European varieties.



FIG. 153. Leaf of *Pyrus variolosa*.

“*Pyrus variolosa*—This species is one of the most promising types in our collection. The tree is a beautiful, vigorous, upright grower. It makes a good union with our cultivated varieties and should prove valuable as a stock for topworking. This species, while not immune to blight, is very resistant. During the summer of 1915 a large number of inoculations were made into the tips of young branches, and these usually would blight back for a distance of three to five inches. During 1916, a very favorable season for pear blight, the disease would extend down young branches as much as twelve to eighteen inches, and in one case as much as two feet. Seventy-seven inoculations were made into the trunks of two-year-old trees. All but seven of them failed to develop the disease. In the successful infections, only small superficial cankers were produced. In these cankers a new cambium would readily form, and the entire wound would heal over perfectly in a short time.

“The origin of this species or type is still a matter of dispute. It has been confused with *Pyrus pashia* of northern India, from which species it is very distinct. *Pyrus variolosa* produces medium-sized, pear-shaped fruits, which have a persistent calyx. It is possible that this is not a distinct species, but a hybrid. If this should prove to be the case it probably will not come true to type from seeds. This matter will be determined by a study of the seedlings of this type. If this does not come true to type from seeds, the seedlings will be of little value for a root stock. If this should prove to be the case, it will, nevertheless, be of value as a stock for topworking, when propagated by budding or grafting on some other root system.

“*Pyrus ovoidea*, Rehder—This ranks second only to *Pyrus ussuriensis* in blight resistance. During 1915 we were unable to get the disease to develop more than four inches even in vigorous-growing shoots of the species. During the very favorable season of 1916 vigorous shoots would blight down as much as fifteen inches. As soon as it reached the hard wood of the previous season it would stop. All the inoculations into one and two-year-old trunks have failed to develop the disease.

“The trees are vigorous growers, and produce medium-sized fruit, which is egg-shaped, and has a persistent calyx. This species is a native of northern China, and was formerly known as *Pyrus simonii*.”

Not only is it desirable to secure a root that possesses a high degree of resistance or immunity to blight, but also a trunk which will not develop the disease to any extent. While the Kieffer is more resistant than others of our well-known varieties it often blights badly. In

the Talent experimental orchard, Reimer is using a variety known as Surprise with splendid results. We quote from him again as follows:

"We obtained propagating wood of the Surprise from the Horticultural Department of the Missouri Experiment Station. There two large trees of this variety have never shown any blight while other varieties of pears in the same orchard surrounding these trees have suffered severely from blight; many of them have blighted to the ground. During 1915, many inoculations were made into this variety. When inoculations were made into the tips of tender young shoots, they would blight back for a distance of only three to four inches. Inoculations made into the trunks of two-year-old trees failed to develop the disease. The season of 1916 proved very favorable for the development of pear blight, and hence was ideal for testing the blight-resisting qualities of this variety. A large number of inoculations were made into the trunks of one and two-year-old trees on several different dates. Many of these inoculations failed entirely, while many produced small superficial cankers in which the disease soon died, and then these wounds would heal over perfectly. In two trees rather large wounds were produced. These, however, soon healed over. Check trees of many other varieties and types inoculated at the same time and in the same manner and with the same lots of bacteria were killed by the disease.

"The Surprise is an extremely vigorous grower, with an upright slightly spreading habit, making a desirable tree for topworking. Young trees topworked on this variety are making a very fine growth.

"The origin of the Surprise is not known. A few trees of this variety were sent out by Stark Bros. Nursery for testing purposes about fifteen years ago. Their records do not show where the variety was obtained."

The work in Oregon offers much encouragement for California pear growers. We must not, however, be too hasty in our conclusions and before definite recommendations are made for this state there should be careful experimental work done with these promising varieties and species under our conditions. Mr. A. L. Wisker of Grass Valley has been one of the pioneers in the work of experimentation with Japanese roots and results have been fairly satisfactory, so much so in fact that he, as a practical nurseryman, has given up the use of the French root for propagating purposes, with the result that other nurserymen in the state have followed his example.



FIG. 154. Leaf of Surprise.

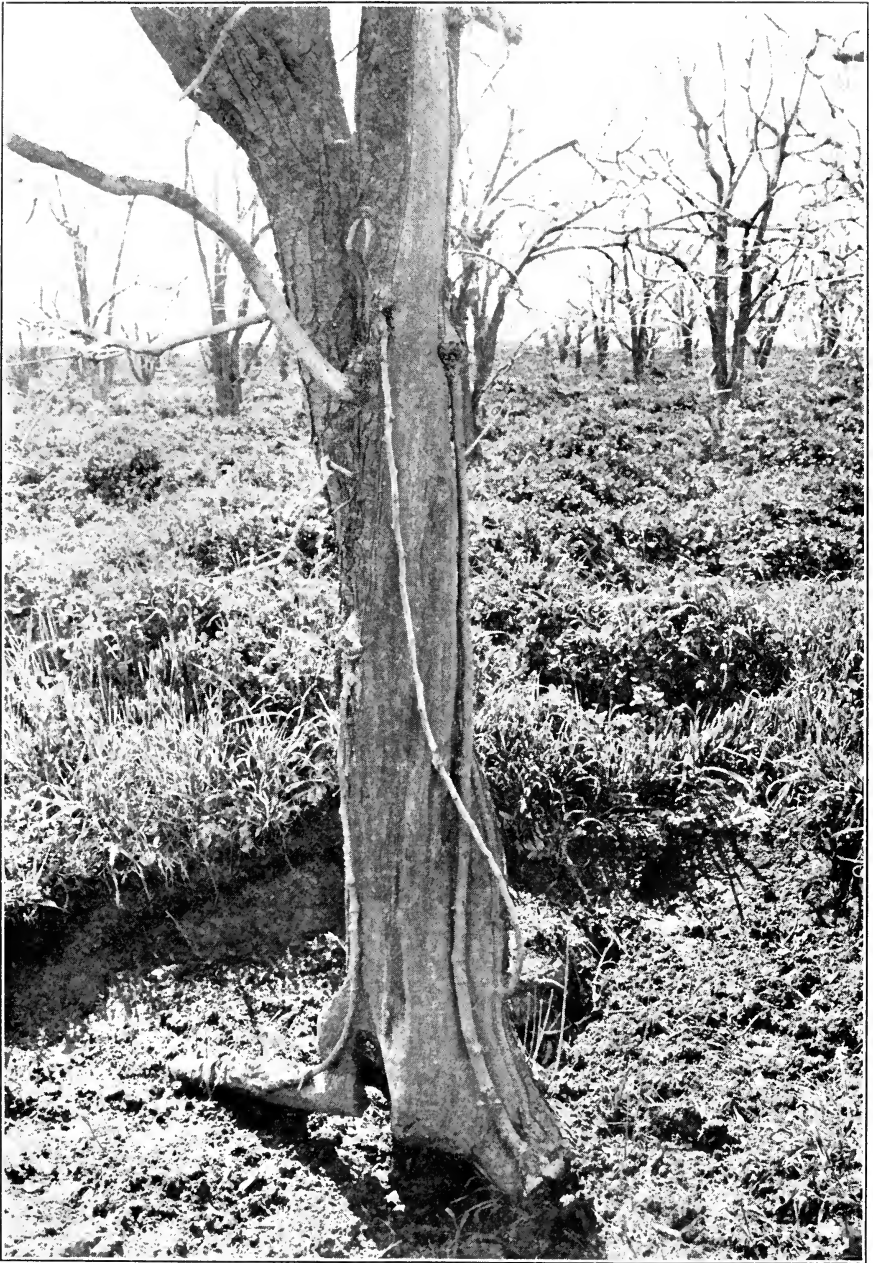


Fig. 155. Bridge-grafting of a tree which has been badly injured in pear blight control work. Scions used in this case were about five feet in length.

**BRIDGE-GRAFTING AFTER REMOVAL OF LARGE AREAS OF BARK IN BLIGHT WORK.**

In cases where it has been necessary to remove so much bark that the tree is endangered because of the sap not being able to flow in sufficient quantities from the roots to the branches and vice versa, it becomes necessary to bridge-graft. If a tree is completely girdled, then this is the only means of saving it; if only partially girdled it may live and thrive without such grafts. Not many of the California pear growers who have found it necessary to carry on a campaign against blight in their orchards have resorted to the use of these grafts, but have considered that a tree when girdled by blight was not worth trying to save. There is no question that under certain conditions their use pays. Figs. 155 and 156 illustrate this work as it has been done in one of the leading pear orchards of the Sacramento Valley. Some of the scions used in this orchard are six feet or more in length. The process of grafting is simple, consisting merely in the insertion of one end of a twig in the good bark below the injured portion and the other end in the same manner above. As in all grafting operations it is only necessary that the cambium layers of the trunk and scion come in contact at some point where union will take place. The ends of scion can be cut in any convenient way to bring this about. After insertion beneath the bark the ends are carefully waxed over to exclude the air and to prevent drying. Once union takes place they grow very readily. Water sprouts growing from below a girdle or injury may be utilized by cutting off and grafting in the upper end in the good bark above the girdle. It may also be practical at times to plant young trees by the side of old ones for the purpose of grafting them into the trunks of the latter when they serve exactly the same purpose as the grafts in the other cases mentioned.

**PREVENTIVE MEASURES.**

Since rapid, succulent conditions of growth are favorable to blight it follows that anything which will prevent such growth will retard the disease. For this reason it is not best to fertilize too heavily when trees are growing under conditions that are very favorable and which are inclined to bring about excessive growth. An abundance of water may have a similar effect in lessening the trees' resistance to blight. Therefore withholding irrigation water in times of serious blight epidemics may render the trees less liable to contract the disease.

The control of insect pests which serve as carriers, and which inoculate the trees with the blight organism is another important factor in the control of the trouble. One of the most troublesome insect pests is the ant. There are various species which may be found in orchards. They are especially bad when the trees are infested with aphids or scale insects, as the droppings of these insects, known as honeydew, are a favorite food of the ants. These pests are so exceedingly active that they crawl over all parts of a tree and wherever a case of holdover exists, they are almost sure to carry it to the blossoms where infection takes place. The disease may then be readily carried by bees and other blossom visitants among the insects. This illustrates the great





FIG. 156. Water sprout used to bridge over the trunk of a tree from which bark has been removed in blight control work.

importance of the ant as a blight spreader and the necessity for its control. One of the most practical methods of preventing ants from getting into the trees is to apply a band of the sticky tanglefoot preparation to the trunks. For years the O. & W. Thum Company have been manufacturing this material for insecticidal purposes. It is safe to apply direct to the trunks of trees, as years of experience have proven, and while fresh, at least, no insect can cross over it. Some difficulty is experienced in keeping it fresh enough for any length of time to prevent the ants, which are very strong, from crossing over. Consequently,



FIG. 157. Tree tanglefoot around the trunk of a blighted tree to prevent ants from crawling up the trunk and thus distributing pear blight organisms.

when used to control ants it should be freshened every few days by adding a new supply or by disturbing the surface of that already applied so that it possesses its original sticky characteristics.

Another very important group of insects bearing a close relation to the spread of blight, are the aphids. Spraying with a good contact insecticide, *e. g.*, nicotine sulphate, to control these pests is important during a season of severe blight infestation. The various species of mites which feed on the pear are no doubt also responsible for spreading blight and should therefore, if for no other reason, be controlled. Since the blight is due to a bacterial organism and can not become started in a tree unless the organism is placed there by some outside agent, and since the insects have been proved to be the agents most generally concerned in the work of carrying the germs and inoculating the trees, every effort should be made to reduce the numbers of injurious species to a minimum in the orchards.

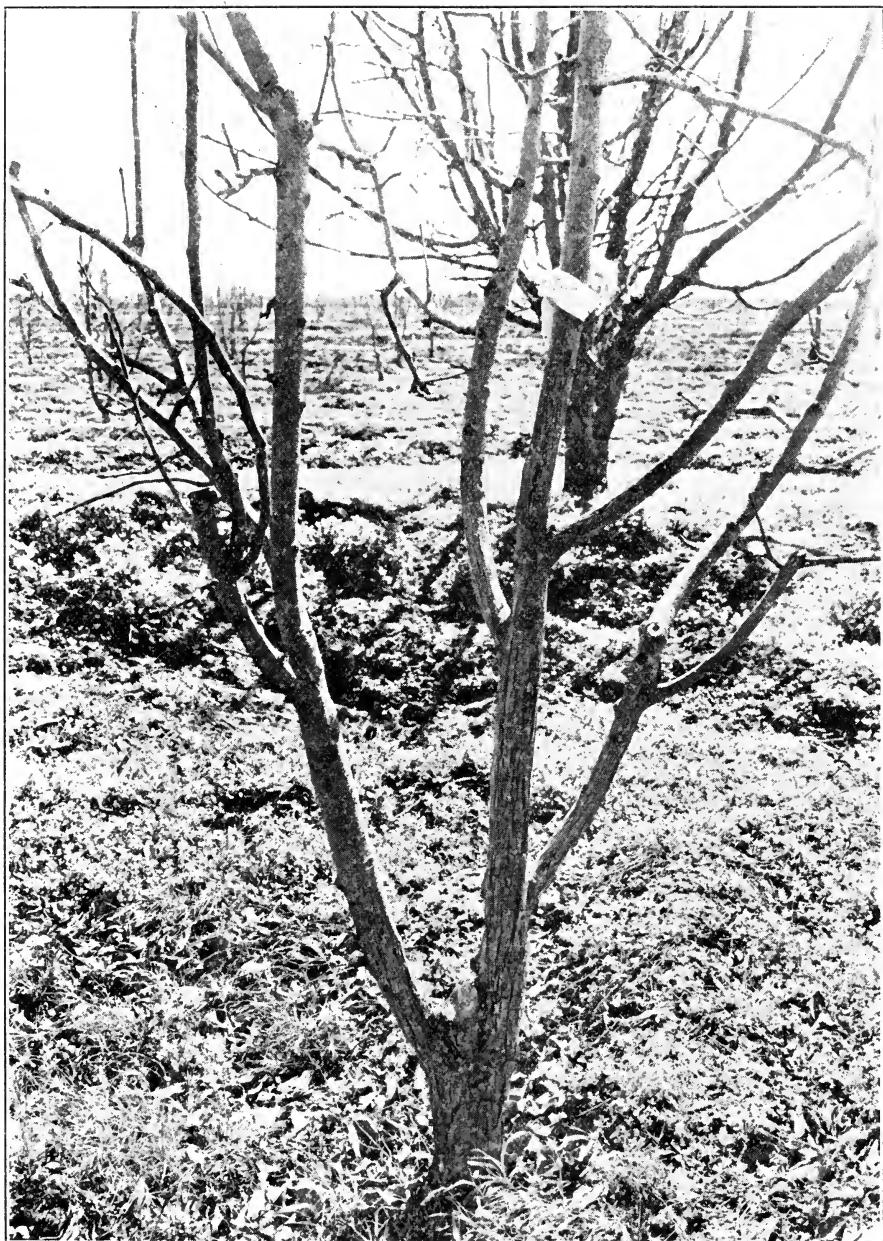


FIG. 158. Tree which has been completely girdled by pear blight saved by scraping the bark from the surface and applying Bordeaux paste.

**NEW METHOD OF BLIGHT CONTROL A POSSIBLE SUCCESS.**

Fig. 158 illustrates a type of tree, thousands of which have been uprooted because of complete girdling by blight. An examination of the picture will show that from a point just below the handkerchief on the main central branch, to the ground, and also for a considerable height on the other two main branches the bark has been scraped away. From the ground to the handkerchief is about 5 feet and for this entire distance blight had completely girdled the tree. By scraping away the outside bark, removing just as little of it as possible, and applying a concentrated Bordeaux paste the tree was saved and the cracks seen in the bark are due to the development of the healthy growing layers underneath.

Work of this nature has been done for the past year in the Hayward Reed orchard near Sacramento, and, according to Mr. Reed, trees which at one time were considered hopeless cases can be saved providing that the bark has not been killed when the infection is discovered, and providing that prompt measures are taken in scraping away the outside bark from every square inch of diseased surface, treating same with Bordeaux paste or concentrated lime-sulphur. Prior to the application of either of these the wound should also be disinfected with corrosive sublimate.

Experiments were made without the use of Bordeaux or lime-sulphur, with the idea that exposure to the sunlight and air would kill the bacteria. Some cases treated in this manner recovered, but in most cases the disease was only temporarily checked. The hundreds of trees saved after the application of either Bordeaux or lime-sulphur indicate that there is a possibility of very successful control work along the lines suggested. The method is not recommended except for trial, because of the fact that insufficient work has been done to justify such a recommendation, and hasty conclusions might lead to serious consequences.

**PEAR CANKER.**

In Vol. I, No. 7, of the Monthly Bulletin of the California State Commission of Horticulture, Professor H. S. Fawcett described a canker of pears from material that he received from El Dorado County. Apparently this canker was due to the fungus *Sphaeropsis malorum*. The following is quoted from his article:

“In the center of the affected spot is a small circle of cracked bark. This is surrounded by larger elliptical rings of cracked bark with the longer axis of the ellipse in the direction of the branch. Professor R. E. Smith refers to this canker under the head of “Curly Bark of Pear” (Bulletin 218, California Experiment Station). Cankers due to the fungus *Sphaeropsis malorum* have often been reported on apple, quince and pear trees in the Eastern states. The same fungus also causes a rotting of the fruits known as black rot.” Removal of cankers as in pear blight is recommended.

Cankers may also be due to species of *Nectria* which have been found attacking apple trees with the formation of similar cankers.

**CROWN GALL (*Pseudomonas tumefaciens*).**

While pear trees are not so susceptible to this disease as the stone fruits, they are nevertheless frequently infected and it becomes necessary to carefully inspect all nursery trees for this trouble. Crown gall is a bacterial disease which corresponds very closely in its effect upon plants to cancer in the human being. This disease is shown on pear trees in Fig. 159. Like cancer, there is no cure after the disease becomes well established in a tree. Experiments have been conducted in which the galls have been cut from the trees and the wounds disinfected with Bordeaux paste or some other disinfectant. It seems

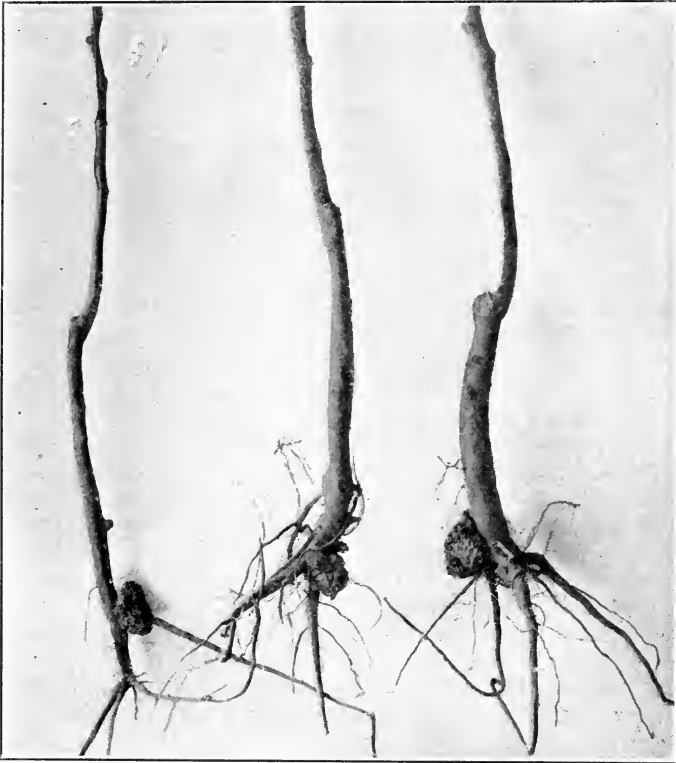


FIG. 159. Pear nursery trees badly infected with crown gall.

impossible to cut away every portion of the disease, consequently a recurrence can always be expected after such treatment. Preventive measures, therefore, must be carefully considered and all young trees that show signs of crown gall should be discarded at the time of planting orchard.

**OAK ROOT FUNGUS (*Armillaria mellea*).**

This is a very serious disease which attacks most of the deciduous as well as citrus fruit trees and olives. The pear is apparently less susceptible than many other kinds of trees, *e. g.*, prunes, peaches and

almonds, but under favorable conditions the trees contract the disease. The fungus attacks oaks and other wild native trees and fruit trees become infected when their roots come in contact with diseased roots of other trees in the soil. The fungus lives on dead roots until they have entirely decayed, consequently fruit trees may not contract the trouble until years after they have been planted.

The growth of the fungus on the bark of roots and crowns causes decay and death of the affected parts. Girdling and death of infected trees ultimately takes place.

The nature of the disease does not favor a rapid spread throughout an orchard, and it is usually detected by more or less circular areas of dead trees. These areas are due to the spread of the disease from a common center of infection by contact of good roots of surrounding trees with those that already have the disease.

#### Control.

Professor W. T. Horne\* of the Department of Plant Pathology, University of California, has done more work than any one else in the state to determine methods of control. First of all he recommends the removal of all roots as far as possible from new land before planting to trees. Growing alfalfa for a few years prior to planting is also suggested. Experiments with citrus were conducted by Professor Horne in limiting the affected areas by trenching. No doubt this work could be just as successfully done with pears as with oranges. We quote from his Monthly Bulletin article, referred to in footnote, as follows:

“One spot ditched was in an orange orchard in good, mellow soil, trees good and more than ten years old. There were two dead trees and two infected at the root but with the tops still fine. The ditch was made 3 to 3½ feet deep, no wider than necessary for digging. It seemed to have cut all the roots. Infected roots could be readily recognized. As finished it was believed that no diseased orange roots crossed outside the ditch. A layer of tarred building paper of good quality was put against one side of the ditch to prevent new roots from crossing back into the diseased area.

“After a little more than two years the ditch was reopened. The building paper was worthless for stopping the roots, as they grew through it very readily. The rest of the experiment was highly encouraging. In repeated cases a root from which a piece had been cut out could be recognized unmistakably on the two sides of the ditch. The piece within the diseased area would be in an advanced condition of decay with the fungus, while the end toward the unaffected tree and outside the diseased area would be entirely unattacked and putting out numerous new roots. There could be no reason to doubt that if the ditch had not been made the fungus would surely have followed the root and there would have been no hope of saving the tree. Around this area, which included four diseased trees, no less than five good trees were saved from infection. If once opening the ditch will save the sound tree from infection for two years, there is no reason why the thing can not be done again in the same place and the spot permanently restrained to its present area.”

\*Monthly Bulletin, State Commission of Horticulture, Vol. III, No. 7.

## PEAR SCAB.

Next to pear blight scab is the most serious disease of pears. Unlike the blight, which affects the tree itself, scab attacks the fruit and foliage. Despite spraying methods, which are satisfactory in the control of this disease it annually causes a heavy loss of pears because of inattention to spraying or because of faulty methods or failure to make applications at the right time.

Pear scab is due to a fungus called *Venturia pyrina*. Its occurrence is common throughout the pear-growing districts of the state, but more or less seasonal. For example, in 1915 there was practically none of the disease in the pear-growing districts of the Sacramento Valley. Spraying could not account entirely for the almost total absence, as there was little or no scab in orchards not sprayed. In 1916 just the reverse was the case and except in orchards where the spraying was done just right and at just the proper time, there was so much infection that a large percentage of the pears were not fit to pack and were utilized by the canneries with considerable wastage. Again, in 1917 the scab was not at all bad in the Sacramento Valley and wherever the least effort was made to control it little difficulty was experienced with its attack. Weather conditions are no doubt responsible for the prevalence of the disease during certain seasons. As humidity, and heat generally, favor the development of any fungous trouble we would expect such conditions in the early spring, as the buds are unfolding to favor the development of this fungus.

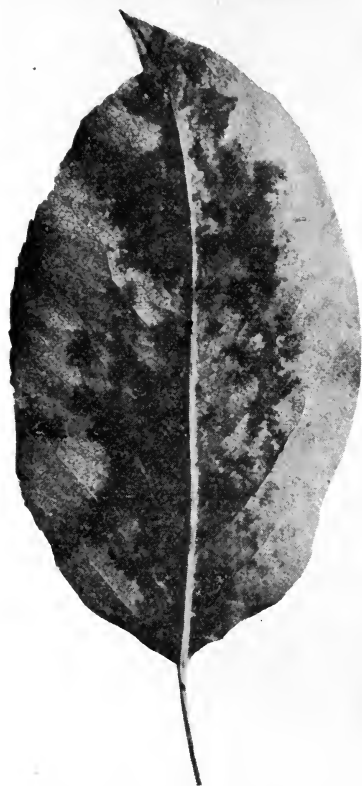


FIG. 160. Pear leaf showing infection with scab fungus, *Venturia pyrina*.

The presence of the disease in an orchard is recognized by sooty-like blotches on the underside of the leaves and bluish, more or less circular roughened patches on the surface of the pears. As the fungus dies and becomes inactive these patches change to brown, roughened, scabby areas which check the growth of the fruit at places of attack, thus causing distortion and abnormally-shaped pears as the one shown in Fig. 161. The injury to the fruit is local, affecting principally the surface, and causing slight discoloration and noticeable hardening underneath the skin. But for the distortion scabby pears would not be nearly so objectionable.

**Treatment.**

As the fungus spends the winter on foliage that has fallen to the ground the spores being discharged from this dead foliage in the spring, it is necessary to get rid of all leaves in the orchard in some manner so that the spores can not infect the new growth. On account of the fertilizer value of the leaves they should not be burned or destroyed, but



FIG. 161. Pear infected with scab. (After R. E. Smith.)

should be plowed under, in which case there would be no chance of the spores getting into the trees. This in itself is not sufficient for control as there will be spores on the trees and spraying is always necessary in orchards where scab is present year after year.





FIG. 162. Pear buds showing stage of development when second application for scab should be made. (Photo by Claude Van Dyke.)

made at as nearly the right time as possible each spring. This application must be followed by a second in about one week, or when the cluster buds have begun to separate, as shown in Fig. 163. Both sprayings should be made with the utmost care and in the most thorough manner. A high pressure is desirable in order that the spray may penetrate into the cluster of buds. Either lime-sulphur solution or Bordeaux mixture may be used for the first two treatments. Lime sulphur should be applied at the strength of 1 gallon of lime sulphur to ten gallons of water, and Bordeaux at the regular dormant strength of 20 pounds copper sulphate, 25 pounds lime to 200 gallons of water. Bordeaux paste to be diluted with water is now available and serves the purpose just as well as the home prepared mixture.

A third treatment for scab is necessary in combination with the first spraying for codling moth, or at the time when the blossoms have dropped from the trees. At this time arsenate of lead and Bordeaux mixture, or arsenate of lead and atomic or milled sulphur can be used. In this case

Early dormant spraying, at one time thought to be necessary in the control of scab, is not important, but spraying when the buds are beginning to unfold, as illustrated in Fig. 162, should never be neglected. Failure to apply a fungicide when the buds are practically in this stage means failure to control the disease. Therefore promptness is necessary during seasons when scab conditions are favorable. As no one can foresee these seasons there should be no chances taken and the treatment



FIG. 163. Pear buds showing stage of development when first spraying for scab should be made. (Photo by Claude Van Dyke.)

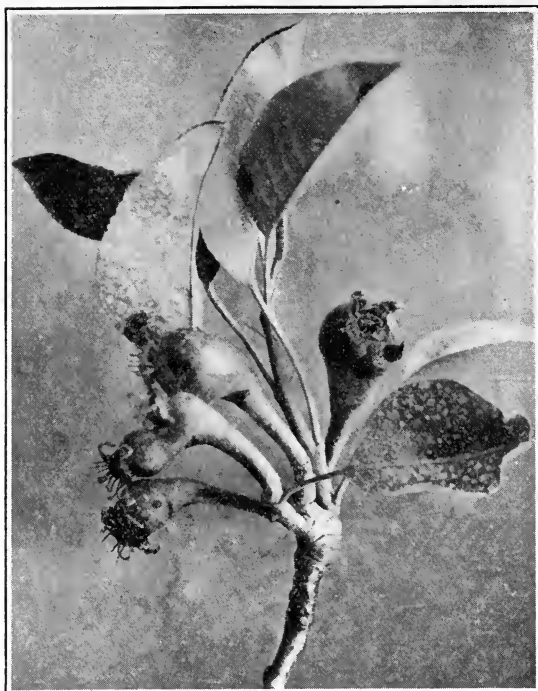


FIG. 164. Young pears in proper condition for first codling moth spray and third spray for scab. (Photo by Claude Van Dyke.)

the strength of the Bordeaux should be reduced to 15 pounds copper sulphate and 20 pounds lime to 200 gallons of water. In sections where thrips are troublesome it may be necessary to use nicotine sulphate in combination with the first two scab treatments.

## CHAPTER XIV.

## INSECT, MITE AND OTHER ANIMAL PESTS OF THE PEAR.

Pear trees are attacked by such a variety of insect pests that in order to be most successful in pear culture it is desirable that the grower be able to recognize the various species and to know what treatment is necessary for their control. The most cosmopolitan and important of these pests have been treated somewhat at length, while those of lesser importance have been mentioned very briefly. The fact, however, must not be overlooked that certain insects that are of lesser importance in one locality may be very serious somewhere else and even though such pests as leaf roller and thrips have not been described in detail there are certain parts of California where they are exceedingly serious. In the case of codling moth it may be considered to be the most cosmopolitan of all and in practically every pear-growing section of the state its ravages are seen, and spraying for its control is absolutely necessary.

**CODLING MOTH (*Carpocapsa pomonella*).**

This serious insect pest of the pear and apple is more easily controlled in orchards of the former fruit than in those of the latter, and while spraying must not be neglected in pear orchards wherever this insect occurs, the exacting precautions which are necessary in badly infested apple orchards are not necessary when spraying the pear.

**Habits.**

The different stages of the pest are as easily recognized in pear as in apple orchards, when equally abundant. The winter season is always passed in the mature larval stage, under loose bark, in cracks of the trees, in packing houses where fruit was packed during the season and in various other places. The wintering larvæ are protected by tough, impervious cocoons of silk. As soon as the weather gets warm in the spring they become somewhat active, and pupate within the cocoons, from which emerge the mature moths of the first or spring brood. The earliest of these moths appear in the orchards about the time when the trees are in full bloom, but the majority do not emerge until later, or when the fruit is approximately  $\frac{1}{2}$  inch through at the widest part. The difference in time of the emergence of moths may be due partly to the length of time the larvæ have been in hibernation, but more likely to a difference in their location, some being in warm, sunny situations, and others in cool, shady places which have a tendency to retard their development. The mortality among hibernating larvæ is often very great, but varies with seasons. As the abundance of first brood larvæ in the fruit depends upon the number of hibernating larvæ that survive the winter season, the natural mortality is exceedingly important, and has a direct bearing on the number of applications of a spray for the control of the insect.



FIG. 165. Codling moth larva in pear.

Eggs are laid by the female moths shortly after mating, on the upper surface of the leaves surrounding a pear or cluster of pears, or on the skin of the pears themselves. They are deposited singly. Most of the larvæ upon emergence from the eggs enter the fruit by way of the calyx and feed within until full grown, when they emerge for pupation. Thus the life cycle of the first brood is completed, and a second develops in a similar way. In some states, and possibly in some parts of California, there is at least a partial third brood during the season. The time occupied by the different stages in their development varies with locality and season.\* In this general discussion it does not seem best to go into details regarding the pest's life history.

#### Control.

The entrance of the newly-hatched larvæ by way of the calyx or blossom end of the pear has made control by means of poison sprays directed into the calyx cavities exceedingly effective. From one to three applications are necessary for the complete control of the pest. Arsenate of lead in paste form at the strength of 3 to 4 pounds to 100 gallons of water, or in powder form 1½ to 2 pounds to 100 gallons of water are sufficient. If scab is also present this spray is combined for convenience with a fungicide, as recommended for the control of this disease, but in the absence of scab or other fungous diseases only the arsenate of lead is necessary. There are other arsenicals, *e. g.*, Paris green and arsenite of zinc, that may be used instead of arsenate of lead, but the latter is now considered standard.

#### Application.

The first application for codling moth should be made when the petals have dropped. A delay of a few days will not materially interfere with codling moth control, as the pear does not close its calyces quickly; in fact, many varieties do not close at all. The Bartlett in most cases has an open calyx into which the spray may be directed any time during the season. Spraying should not be neglected until hatching of the codling moth eggs has begun and for fear that it might be too late for the earliest worms the safest rule is to make the first application as soon as the petals have fallen. A second spray should follow in about three weeks' time and a third in two weeks from the second. Spraying in each case must be done with the greatest of care. The first spray should result in practically every calyx cup receiving a supply of the poison. The later applications are designed to cover the small fruit with the poison also, so that the small percentage of worms entering the side may be killed.

\*S. W. Foster, U. S. Department of Agriculture, in Bulletin No. 97, Part II, of the Bureau of Entomology, states that "the codling moth in California presents certain differences in its life history as compared with what is true of the East, principally a lengthening of the respective stages due to a lower mean temperature during their period of development, especially in the first generation." Mr. Foster's records were made in Contra Costa County, where he worked with the codling moth in pear orchards.

**MEALY BUG (*Pseudococcus* sp.).**

In a limited area bordering on the Sacramento River, near Courtland, some species of mealy bug has for several seasons past been of considerable economic importance. This pest does its principal damage in the calyx end of the pear. It enters the basin where feeding takes place, with the result that the juices of the pear ooze out, forming a sticky mass of gum. The egg masses are laid on the trunks and branches of the trees.<sup>1</sup>

**Control.**

Very successful control has been accomplished by means of miscible oil sprays, Formula No. 7.\*

**BEAN THRIPS (*Heliethrips fasciatus*).**

Late in the summer season pear growers frequently notice considerable injury from thrips. Generally the species present at this time is the common bean thrips. This species is recognized by its black color and white tips to the antennae and the white markings at the base of wings.

**Control.**

Essig, in "Injurious and Beneficial Insects of California," recommends the use of a formula prepared by J. R. Watson of the Florida Agricultural Experiment Station, which is as follows:

Commercial Lime Sulphur (33° Baumé)-----	5½	gallons
Black Leaf "40"-----	14	fluid ounces
Water -----	200	gallons

Successful control may also be accomplished by the use of Formula No. 3 or 11.

**BLACK SCALE (*Saissetia oleæ*).**

Occasionally a bad infestation of black scale occurs on pear trees. This pest is easily recognized by its characteristic black color and the presence of an "H" shaped marking on the dorsal surface of the scale. The young scales first feed upon the foliage of affected trees, later detaching themselves and going to the branches. The winter season is spent in a partially grown condition.

**Control.**

A dormant spray, using Formula No. 5, 6 or 7, applied any time after the trees become dormant in the fall and before growth begins in the spring will bring about effective control.

**BRANCH AND TWIG BORER (*Polycæon confertus*).**

This borer is widely distributed throughout the state but can not be considered extremely serious. The adult is a small brown beetle which lays its eggs on the twigs of various kinds of trees, including the pear.

\*Formulae for control on pages 183 to 188.

<sup>1</sup>This species is apparently the same as the grape mealy bug, *Pseudococcus bakeri*.

The larvæ usually bore into small crotches, forming a characteristic round-shaped burrow. Often injury is severe enough to cause the twigs to break. This pest is usually more serious in the neighborhood of brush piles, in which it hibernates and breeds.

**Control.**

Nothing in the way of a spray can be used effectively for this pest; in fact it is not serious enough to make radical measures necessary. Cleaning up of all brush piles, orchard prunings, etc. is the most important thing in connection with its control.

**BUR CLOVER OR COW PEA APHIS (*Aphis medicaginis*).**

Aphids are often exceedingly troublesome in the pear orchard and because of the fact that they may spread the blight from tree to tree, control becomes absolutely necessary in orchards where the blight is present. This species is black in color, with distinct white markings on the legs. It commonly feeds on leguminous plants, sweet clover, bur clover, etc., attacking pear trees when there is a scarcity of its common food plants. It feeds upon the tender growing tips of the pear twigs, sometimes becoming exceedingly abundant.

**Control.**

Formula No. 3 may be used very successfully in the control of this pest, as well as other aphids which affect the pear.

**CALIFORNIA PEAR SAWFLY (*Gymnonychus californicus*).**

In the pear orchards of the Central California Coast Region slight damage is often done to the foliage of pears by a little green larva which eats a characteristic circular-shaped hole in the leaves. Frequently feeding begins on the margin, the larvæ gradually eating back in the manner shown in Fig. 166. The adult insect is a little shiny black fly with yellow markings, one of many species of a family of insects known as sawflies.

**Control.**

Use Formula No. 12.

**CHERRY OR CALICO SCALE (*Lecanium cerasorum*).**

In some of the counties surrounding the San Francisco Bay this scale, which is an exceedingly large, showy, black and white species, is common.

**Control.**

Control measures are not usually necessary, although when the pest becomes abundant enough to be destructive either Formula No. 5, 6 or 7 may be used.

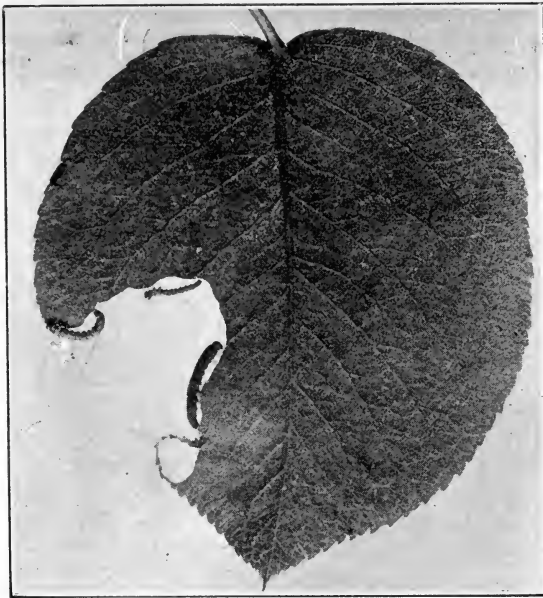


FIG. 166. Larvæ and characteristic injury of California pear sawfly, *Gymnonychus californicus*.

#### COTTONY CUSHION OR FLUTED SCALE (*Icerya purchasi*).

To the writer's knowledge this species has never been found injuring pear trees except in that part of the Central California Coast Region included in Santa Clara County. In certain orchards there it has become exceedingly destructive particularly on Winter Nelis, and is considered by the pear growers to be one of the most serious pests of this fruit. It attacks the smaller twigs, devitalizing them, and, as is characteristic of all scale insects, the trees are covered with a sticky honeydew. This same pest occurs generally in citrus orchards but is there controlled by its natural enemy, *Vedalia cardinalis*. It is interesting to note that in the case of the pear the *Vedalia* can not long exist because of heavy spraying with arsenate of lead for the control of codling moth. This material, while it has no effect upon the cottony cushion scale, does poison the ladybirds, consequently the scale has a chance to develop.

#### Control.

Much experimental work has been done in the Santa Clara Valley by the county horticultural commissioner in an effort to determine effective methods of control. Thus far nothing has been discovered that is altogether satisfactory. More or less good can be accomplished by the use of oil sprays, Formulæ Nos. 5, 6 and 7.

#### EUROPEAN FRUIT LECANIUM (*Lecanium corni*).

This *Lecanium* is of quite common occurrence on pear trees, and but for the presence of the little parasite, *Comys fusca*, it would become very

destructive. The appearance of this species is somewhat similar to that of the black scale. It is, however, brown instead of black, and does not have the distinguishing "H" like marking on the dorsum.

**Control.**

Spray trees very thoroughly during the dormant season with Formula No. 6 or 7.

**EUROPEAN OR ITALIAN PEAR SCALE (*Epidiaspis pyricola*).**

The Italian pear scale is recognized by characteristic pits or depressions which it forms in the bark of affected trees. The color of the scale is almost exactly that of the branches, and as it is very flat its presence would not be easily detected but for the pitting mentioned.

In the Santa Clara Valley this insect is quite common, though not often very destructive.

**Control.**

Use Formula No. 1, 2, 5, 6 or 7.

**FLAT-HEADED APPLE-TREE BORER**

(*Chrysobothris femorata*).

Young pear trees are frequently badly injured or killed by this common species of borer. It is sometimes known as the sun borer, because of the fact that it commonly enters trees that have been sun-scalded. In fact, unless a tree has been injured or weakened in some manner it is seldom attacked by this species of borer. Therefore preventive measures are more necessary than anything else in connection with the control of this pest. The species is recognized by the long, segmented, tapering body with large V-shaped head.

**Control.**

Protect the trunks of young trees by whitewash, Formula

No. 21, or by tree protectors. These are made either of yucca or heavy paper.



FIG. 167. Italian pear scale, *Epidiaspis pyricola*.



**FRUIT-TREE LEAF ROLLER (*Archips argyrospila*).**

Under certain conditions the leaf roller is one of the most destructive pests of the pear. Its presence in the orchard may be recognized during the winter season by little masses of brown-colored eggs, somewhat circular in form and a quarter of an inch, more or less, in diameter. The larvæ feed on the foliage and young fruit, sometimes becoming so abundant as to practically defoliate the trees.

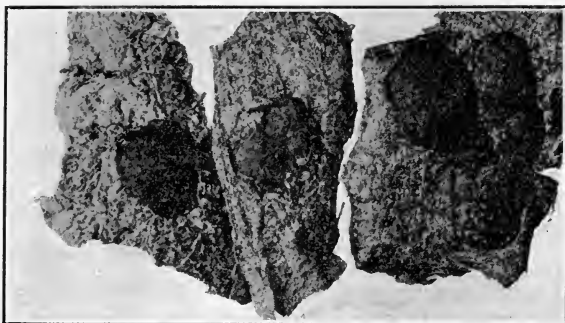


FIG. 168. Eggs of fruit tree leaf roller, *Archips argyrospila*.

**Control.**

Perfect control results from an application during the dormant season of Formula No. 7.

**FROSTED SCALE (*Lecanium pruinosum*).**

This scale somewhat resembles the black scale but is larger, more smooth in outline and is covered with a whitish frosty-like material, from which it derives its common name. It has been known to do considerable injury in pear orchards near the San Francisco Bay.

**Control.**

Use Formula No. 5, 6 or 7.

**GREEN APPLE APHIS (*Aphis pomi*).**

Young pear trees are sometimes affected by this species of aphid, which is rarely seen on older trees. It is the common plant louse of the apple, which it much prefers as a food plant. This is a small green species, with a very characteristic odor, which enables one to detect its presence and to identify it.

**Control.**

Use Formula No. 3 or 4.

**LESSER SHOT-HOLE BORER (*Xyleborus xylographus*).**

Pear growers sometimes find little holes at the base of buds or tunneled into the heart of branches. These are made by the adults and larvæ of a very small black beetle, occasionally becoming quite de-

structive. Like many other borers it prefers trees that are weak, dying or dead. Hibernation and breeding take place in piles of orchard prunings.

**Control.**

It is important, if this pest is troublesome, to remove all dead wood from the orchard and vicinity.

**MELON APHIS (*Aphis gossypii*).**

The melon aphid resembles very closely *Aphis medicaginis*. It works on cotton, melons and many other plants, as well as the pear. On the latter it becomes abundant during certain seasons, its injury being exactly the same as that of the other species mentioned.

**Control.**

Use Formula No. 3.

**OYSTER-SHELL SCALE (*Lepidosaphes ulmi*).**

This scale, while rarely found in California, has been known to occur on young pear trees. It is distinguished by a long, curved, shell-like body. Like other scales, when unchecked it sometimes becomes so abundant that a tree is practically covered with it.

**Control.**

Use Formula No. 1, 2, 5, 6 or 7.

**PEAR-LEAF BLISTER MITE (*Eriophyes pyri*).**

In the Sierra Nevada Foothill and Mountain Region of California the blister mite is a serious pest, especially on younger pear trees. Also pears of the Northern and Central California Interior Valley Region are subject to the attack of this pest, but not to the same extent as those in the previously mentioned region. The injury is distinguished early in the season on the foliage by small reddish

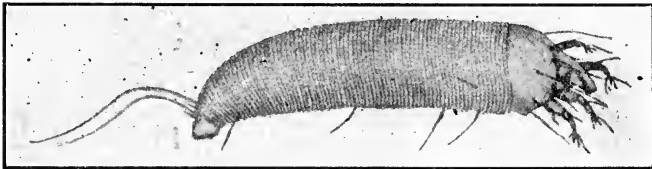


FIG. 169. Pear leaf blister mite. (After Nalepa from Parrott.)

blister-like swellings which later turn black and dry up. An examination of these little blister-like patches will reveal the presence of a little hole on the under surface of the leaf, by which the mites enter and leave the blister. Hibernation takes place under bud scales. The pest is almost microscopic in size and is rarely seen by the average orchardists. The injury to fruit is sometimes severe and consists in russeting and distortion.

**Control.**

Heavy spraying with Formula No. 1 or 2, applied just as the buds are beginning to swell in the spring will control perfectly. The time



FIG. 170. Injury to pears and leaves from blister mite.

of application is very important, as once the larvæ begin feeding in the tissues of the unfolded leaves no spray will reach them. The application must be made just as the mites are leaving their winter quarters at the time mentioned.

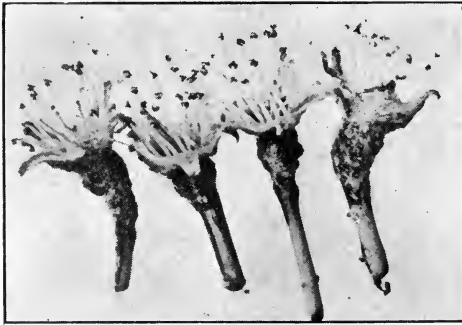


FIG. 171. Pears injured while in bloom by blister mite.

#### PEAR-LEAF RUST MITE (*Epitrimerus pyri*).

This pest was first discovered in California by the writer in 1913. Its occurrence is recognized by a dry rusty appearance of the foliage of pear trees, especially younger trees from one to five years of age. It is even smaller than the blister-mite and singly can not be recognized with the naked eye. Sometimes they are so abundant on foliage that clusters of them may be seen as little dust-like markings on the surface of leaves. Hibernation takes place underneath bud scales, as in the case of the blister-mite.

#### Control.

Formula No. 8, applied any time that the pest appears, will control.

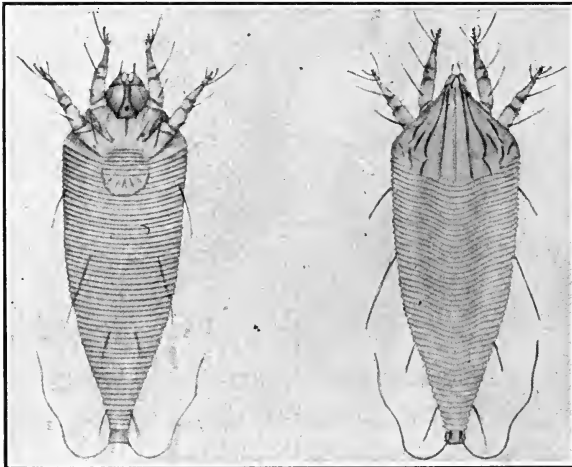


FIG. 172. Pear leaf rust mite. (After Nalepa from Parrott.)

#### PEAR THRIPS (*Tæniothrips pyri*).

In the Central California Coast Region and in the Northern and Central California Interior Valley Region, or that portion lying along the Sacramento River, this pest is probably the most serious insect pest of the pear. Hibernation takes place in the soil and early in the spring

the little black adult thrips emerge, feeding upon blossom buds and blossoms of the pear. At this time eggs are laid, from which there develops a brood of whitish-colored larvæ, which feed upon the leaves and fruit. The principal injury is done by the adults, which frequently are so abundant that the blossom clusters dry up and fail to bring forth any blossom or fruit.

#### Control.

Use Formula No. 11. Application must be made first for the adults as the blossom buds are opening. Later applications may be necessary for the larvæ.

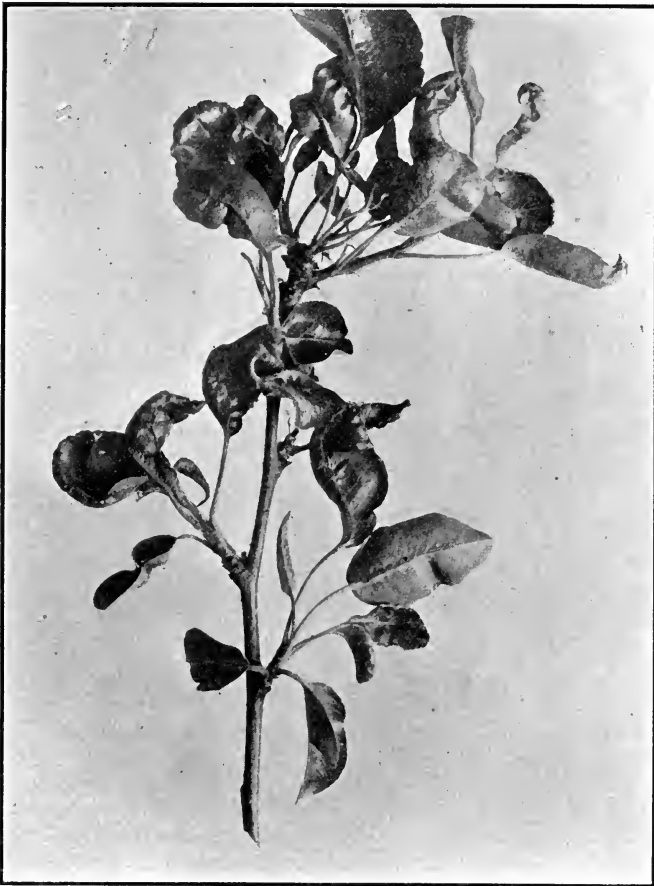


FIG. 173. Injury to pear foliage from thrips, *Taniethrips pyri*.

#### PERNICIOUS OR SAN JOSE SCALE (*Aspidiotus perniciosus*).

It is rather strange that the first state in the Union where San Jose scale was discovered should be so free from it at this time. The fact remains that this pest is of little consequence in California. Occasionally pear trees are attacked, the injury of the pest being recognized by

reddish spots on the twigs and fruit. An examination of these spots will reveal the presence of the little gray-colored or black scale in the center. This scale breeds so rapidly that when nothing is done to control it it may kill portions of trees, if not entire trees. It has never been seen by the writer abundant enough in California to cause great concern.

**Control.**

If control measures are found necessary Formula No. 1, 2 or 7 should be used.

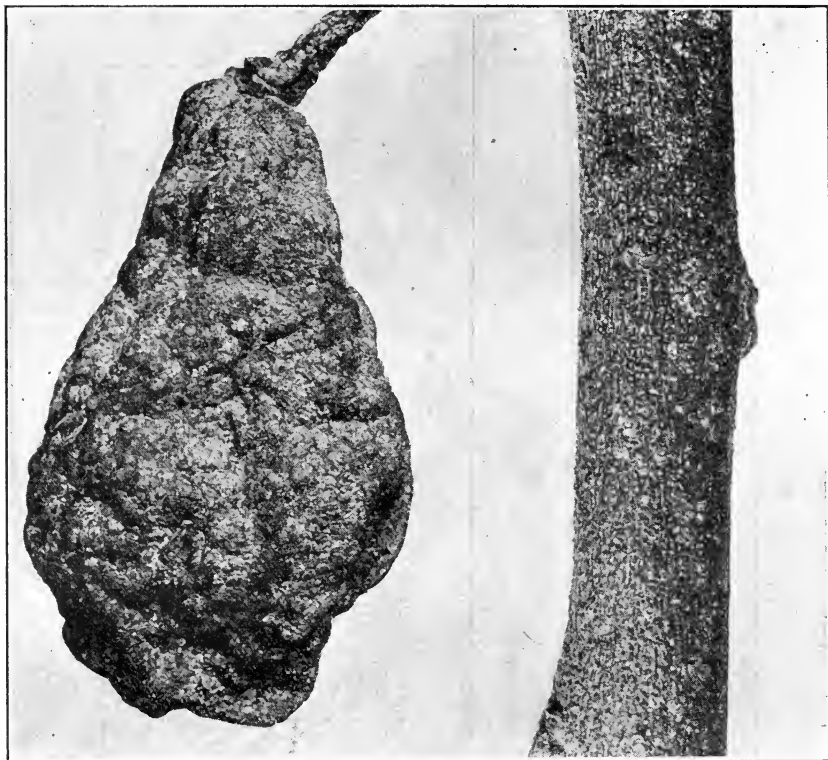


FIG. 174. Severe injury to fruit and twig by San Jose scale, *Aspidiotus perniciosus*.

**RED-HUMPED CATERPILLAR (*Schizura concinna*).**

In the fall of the year defoliation of portions of pear trees is sometimes noticed and is due to the presence of the red-humped caterpillar, a dark colored larva with coral-colored markings just back of the head. The eggs from which these larvæ come are deposited by a moth on the twigs of the pear or other trees. Upon hatching, the larvæ colonize and confine their attack usually to a small portion of the tree.

**Control.**

Often in the evening or early morning the removal of a twig upon which the larvæ are clustered is all that is necessary to destroy the whole colony. In cases where the infestation is bad use Formula No. 12.

**SHOT-HOLE BORER OR FRUIT-TREE BARK BEETLE***(Eccoptogaster rugulosus).*

This species is very similar to the lesser shot-hole borer already mentioned. It is a larger species, however, with like habits.

**Control.**

Same as for lesser species.

**SPRING CANKERWORM (*Paleacrita vernata*).**

Cankerworms may be distinguished from other species of moth larvæ that feed upon fruit trees by the absence of all but two pair of prolegs. They are green or brown in color. Feeding is confined to the foliage, which may be destroyed entirely in severe cases.

**Control.**

Use Formula No. 3 or 12, or the two in combination.

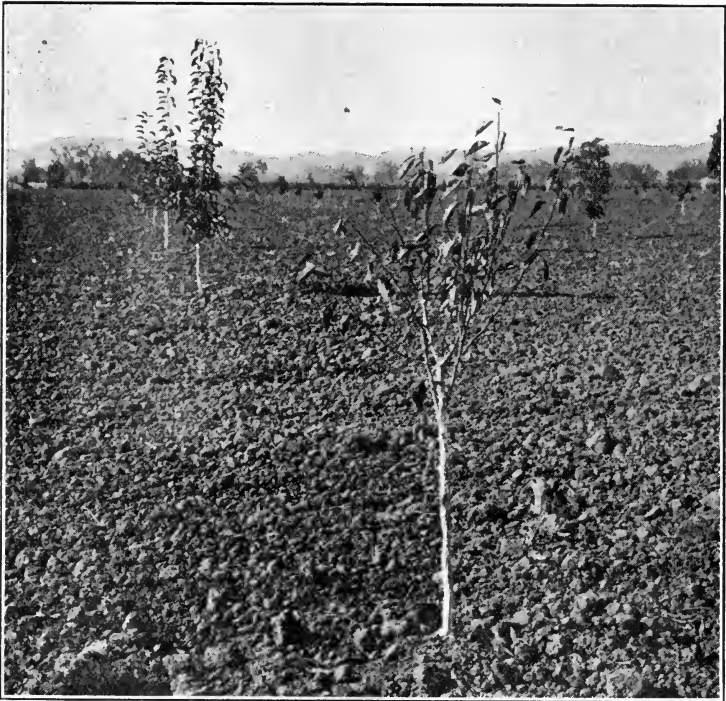


FIG. 175. Young pear tree injured by root aphid, *Eriosoma pyricola*.

**PEAR ROOT APHIS (*Eriosoma pyricola*).**

This very destructive species of plant louse is very similar to the woolly aphid of the apple. Unlike the apple aphid, however, it feeds entirely upon the root system of pear trees. Its attack is confined principally to the very small fibrous roots. In the pear-growing regions north

of Tehachapi this pest occurs commonly. It is particularly bad in some of the nonirrigated orchards of the Sierra Nevada Foothill and Mountain Region and of the Northern California Coast Region. Affected trees may be so stunted that they are not half as large as they should be for their age, thus seriously interfering with their production.

#### Control.

Little can be done to rid affected trees of this pest after they have been set in the orchard. Preventive measures consist of fumigation with Formula No. 19 before the trees are planted.



FIG. 176. Large pear tree showing injury from an abundance of root aphid, *Eriosoma pyricola*.

#### PEAR SLUG (*Caliroa cerasi*).

One of the most commonly distributed pests of the pear and one that is not lacking in importance where orchards are not sprayed with arsenicals is the little deep green slimy larva which devours the upper surface of the foliage. Not infrequently, where no control measures are used, this insect completely defoliates the trees. In California, where spraying is generally practiced for codling moth, orchards that have come into bearing are not troubled, while young trees which do not require an arsenical spray for codling moth are frequently badly damaged.

The adult insect is a little black, two-winged fly, which to the entomologist is known as a sawfly. By means of a small, saw-like ovipositor, from which this family of insects derives its name, the female prepares a semicircular slit in the upper surface of a leaf, depositing an egg in this slit just beneath the epidermis, resulting in a blister-like blemish.



In a few days' time this egg hatches into the characteristic slug-like larva which immediately begins feeding. Their attack begins quite early in the season, about May. Only the upper surfaces of the leaves are fed upon, but sufficient tissue is removed so that they are killed where excessive feeding takes place. The larvæ, when full grown, pupate in the soil and emerge as flies for a second generation after mid-summer. The winter is spent in the pupal stage in the soil of the orchard.

#### Control.

There are few pests that succumb to control measures as easily as this one. As has already been stated, trees that are sprayed with lead

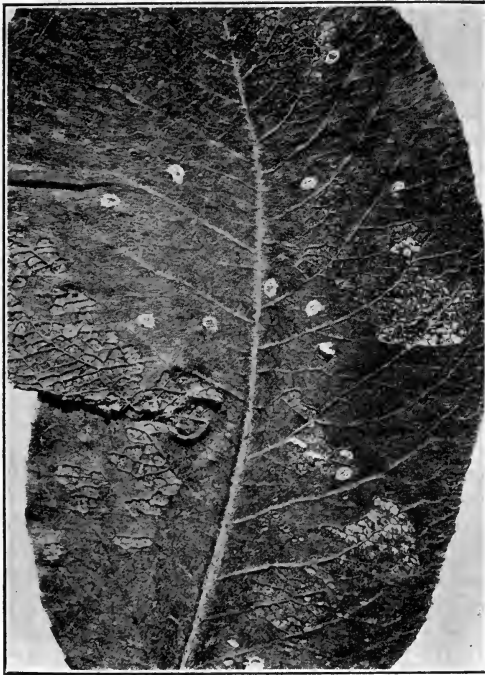


FIG. 177. Eggs of pear slug, *Caliroa cerasi*.

arsenate and other arsenical sprays are not injured, because of the susceptibility of the larvæ to poisoning by arsenicals. Ordinarily, one spraying for the first brood will eliminate the trouble for a season. Should a second be necessary it should be applied as the second brood begins its attack. Spraying with "Black Leaf 40" or any other good contact insecticide is just as effective as an arsenical in killing the larvæ, but has no effect on the eggs, consequently, when contact sprays are used the dose should be repeated in a week or ten days' time. Dusting has been used effectively in the control of pear slugs. Its effectiveness is due to the sliminess of the larvæ which causes the dust to adhere to the surface of their bodies, eventually resulting in death either by

drying up or suffocation. Road dust and air-slaked lime are both very effective, their practical use decreasing in proportion to the size of the trees. The application of any insecticide is greatly facilitated because of the habit of feeding on the upper sides of the leaves, making it absolutely unnecessary to pay any attention to spraying from underneath. While easily controlled, this pest should not be neglected, as frequent defoliation may result in the death of a tree.

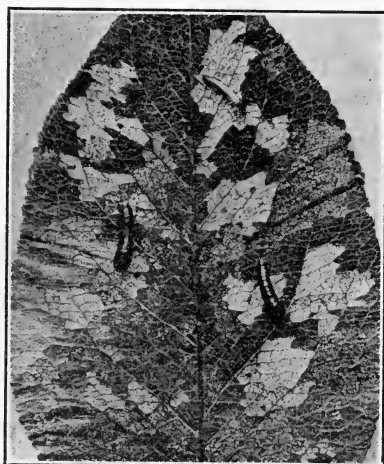


FIG. 178. Larvæ and characteristic injury of pear slug, *Caliroa cerasi*.

#### ANTS.

Various species of this troublesome pest are found in pear orchards, and there is every reason to believe that they are one of the most important factors in the spread of pear blight. In crawling up the trunks and over the branches blight bacteria are carried from live cankers and deposited in blossoms and various other places where they can gain entrance and produce the disease. Once the germs are placed in the blossoms by insects visiting the holdover cankers there is nothing to prevent wholesale spread by bees and other blossom feeding insects.

#### Control.

Tree tanglefoot has already been mentioned as a substance that will prevent ants and other insects from crawling up the trunks. The following formula of the U. S. Bureau of Entomology has been used very successfully in the control of the Argentine ant, and no doubt will prove equally as effective in the case of other species.

Prepare a sirup:	
Granulated sugar -----	12 pounds
Water -----	7 pints
Tartaric acid (crystallized) -----	$\frac{1}{4}$ ounce
Boil for 30 minutes. Allow to cool.	
Dissolved sodium arsenite (C. P.) -----	$\frac{3}{4}$ ounce
In hot water -----	1 pint
Cool. Add poison solution to sirup and stir well.	
Add to the poisoned sirup:	
Honey -----	2 pounds
Mix thoroughly.	

H. S. Smith, in his work of poisoning Argentine ants in the citrus groves of Los Angeles County, recommends the use of either one or one-half pound paper bags as containers for the poison. These are treated with paraffine and tacked to the trunks of the trees after putting in the liquid and folding the top downward. The ants enter by means of holes punched in the bags above the height that it is desired the poison should reach.

#### RED SPIDERS (*Bryobia pratensis* and *Tetranychus* sps.).

The red spiders, or mites, at times become serious in the pear orchard. The former species, more commonly known in California as the almond mite, spends the winter on the trees in the form of small, red, glassy eggs, plainly visible to the naked eye, and usually deposited about the buds or in the smaller crotches. These hatch with the opening of the buds and the tiny mites immediately begin their destructive work, which is confined very largely to the spring months. Later in the season or coincident with the hot weather in June or July, appear other species of the web-spinning mites belonging to the genus *Tetranychus*. The most common and destructive species in California is one that is closely allied to *Tetranychus mytilaspidis*, the citrus species, but apparently not the same. It becomes so bad that frequently more or less defoliation of the trees results if nothing is done to control it. This species also winters in the egg stage. The eggs may be distinguished from those of the brown mite by their redder color, flattened surface with central stem, and usually sparse occurrence on the twigs as compared to those of the brown mite. The common red spider, *Tetranychus bimaculatus*, is frequently found on pear trees, the principal difference in its life history lying in the fact that it hibernates in the soil during the winter months.

#### Injury.

The damage consists in a discoloration and drying of the leaves from which the sap is extracted. Affected foliage presents a yellow, mottled, sickly appearance, the presence of black spots or the droppings always being in evidence. When species of *Tetranychus* are present there is always a fine web spun over the leaves. This collects the dust during the summer time, giving voice to the popular opinion that dust breeds mites.

#### Control.

If eggs of the two species which winter in that stage occur on trees they may be killed by an oil emulsion spray at a dormant strength in the early spring when the buds are beginning to swell. Lime-sulphur applied at dormant strength is also effective, but in this case the spray has no effect on the eggs, killing the young mites as they hatch. Consequently the nearer hatching time of the eggs lime-sulphur can be applied, the better. Lime-sulphur retains its effectiveness for weeks after the application providing excessive rains do not wash it from the trees.

In the summer time all species can be controlled by applications of "atomic" sulphur, "milled" sulphur, lime-sulphur, in fact, sulphur, which is the standard remedy for mites, is effective in practically every

form and it is a common practice to dust trees or other plants with flowers of sulphur.

The important consideration with all summer treatments is the making of the application early before the trees have been damaged. Frequently it happens that some injury is done before the orchardist is aware that the pests are present. Hot dry weather is favorable to their increase, and unirrigated orchards suffer much more heavily than irrigated, which are more vigorous and the conditions of which are more unfavorable for mite breeding.

#### EELWORM (*Heterodera radicolica*).

Frequently the roots of pear and other nursery trees contain small knots or swellings as a result of the attack of the eelworm. This condition is known as root knot and should not be confused with crown gall, which is described in the chapter on Bacterial and Fungous Diseases of the Pear. The so-called eelworm is one of the nematodes or flat-worms of which there are a great many species. Their damage is always worst in light, sandy soils and in the heavier soils there is little danger from them. At times this pest is quite serious, causing the death of fibrous roots, and in severe cases roots of considerable size may be injured or killed. It is a very general feeder, attacking many garden vegetables as well as fruit trees, berries and shrubbery, therefore its introduction into an orchard may be the means of its getting started on other things in the vicinity.

#### Control.

Control measures are preventive and consist in a careful inspection of nursery trees. When found to be infested they should be discarded unless for planting in heavy soil where it is thought that the pest can not thrive.

#### RABBITS.

In many parts of California the rabbit pest must not be overlooked when the orchard is set. Without any warning, and before one is aware that any damage is being done, rabbits frequently play havoc in the newly-set orchard. If the expense of a rabbit-tight fence, the best method of prevention, is considered to be prohibitive, young trees may be protected by placing a cylinder of a small-mesh woven wire about the trunks. If trees are low headed and jackrabbits are present, protection of portions of lower limbs may also be necessary, as these rabbits can reach a considerable height above the ground. Instead of woven wire the ordinary tree protectors of heavy paper or yucca may be used. Whitewash containing aloes (see Formula No. 20) acts as a repellent against rabbits. Without the aloes whitewash is of little value. Salt, which is sometimes used as an adhesive with whitewash, should never be used in orchards where the rabbits can get in as it attracts them, rendering the use of the wash extremely dangerous.

## GOPHERS.

Pocket gophers are frequent orchard depredators. They feed upon tender roots in the soil and any kind of a fruit tree is apt to suffer when they are present. Trees are often completely girdled from gophers gnawing away the bark just beneath the surface of the ground. Raisins and root vegetables, such as sweet potatoes, parsnips and carrots, poisoned with strychnin and placed in their runways will give good results. In irrigated orchards gophers are not usually troublesome because of drowning.

## SQUIRRELS.

The California ground squirrel, *Citellus beecheyi* and varieties, is not usually considered to be much of an orchard pest, yet the writer has often seen their holes in abundance among orchard trees, sometimes certain trees being practically undermined with the burrows. The poisoned barley formula of the United States Biological Survey of the Department of Agriculture, prepared as follows, always controls this pest:

## Formula.

Barley, re-cleaned grain	16 quarts
Strychnin (powdered alkaloid)	1 ounce
Bicarbonate of soda (baking soda)	1 ounce
Saccharin	1/10 ounce
Heavy corn sirup	1/4 pint
Thin starch paste	3/4 pint
Glycerin	1 tablespoonful

In a clean vessel mix thoroughly 1 ounce of powdered strychnin (alkaloid), 1 ounce of common baking soda, and  $\frac{1}{10}$  ounce of saccharin. Crush all lumps of the soda with mixing spoon. To this add  $\frac{1}{4}$  pint of heavy corn sirup and stir thoroughly to a smooth, creamy paste free from lumps. Over this pour  $\frac{3}{4}$  pint of thin hot starch paste and stir well. (The starch paste is made by dissolving 1 heaping tablespoonful of dry gloss starch in a little cold water which is then added to  $\frac{3}{4}$  pint of boiling water. Boil and stir constantly until a clear thin paste is formed.) Add the tablespoonful of glycerin and stir thoroughly, making sure that none of the heavy sirup paste still sticks to the bottom of the container. Pour this mixture over 16 quarts of good, cleaned barley and mix well so that each grain is coated.

For mixing small quantities an ordinary galvanized wash tub is convenient. For larger quantities a tight, smooth box may be used, and the mixing may be done with a spade.

Each quart of the poisoned grain is sufficient for 40 to 50 baits. This quantity *scattered* along squirrel trails, or on clean, hard places on the surface about the holes, will not endanger stock.

N. B.—Strychnin in any form other than the powdered strychnin alkaloid is not effective in the above formula.

## Caution.

All poison containers and all uncleaned utensils used in the preparation of poisons should be kept *plainly labeled* and *out of reach* of children, irresponsible persons, and live stock.

## CHAPTER XV.

## THINNING, PICKING AND PACKING.

## THINNING.

The necessity for thinning pears of the Bartlett variety is usually not great because of the fact that several pickings are ordinarily made, and pears that are too small at the time of the first picking will attain a good marketable size by the time of some later picking. The first picking of Bartletts may be considered as a thinning process. At this time fruit that has attained  $2\frac{1}{4}$  to  $2\frac{1}{2}$  inches is removed. The removal of this fruit relieves the frequently overcrowded condition of the trees and enables the remaining fruit to make a satisfactory growth.

Other varieties may require early thinning for the best results. This is especially true of later maturing sorts and of such small varieties as Winter Nelis. This variety has a tendency to overbear at the expense of size, and heavy thinning may be necessary in order that the pears may be as large as the market demands. In general, pears require less thinning than apples and peaches, but under certain conditions with certain varieties the practice may be followed to advantage, and the individual grower must determine whether or not it will be profitable for him to thin his crop.

In the case of very young trees bearing their first crop thinning to remove an overload will pay. The tendency to allow trees to bear all that they can possibly hold when very young will usually result in the sacrifice of growth and vitality. Therefore, while a reasonably heavy crop will not hurt thrifty trees when they first come into bearing, care must be exercised that they do not overload, with danger of permanent stunting and consequent detriment to future productivity and growth.

## PICKING.

The picking of pears to be packed either for transportation locally or to other states should be very carefully done in order to prevent bruising and subsequent decay. When ready to pick the fruit can be removed easily from the trees by grasping with the hand and quickly lifting upward. If not ready the stems are apt to break instead of separating freely from the fruit spurs. Seldom are the larger varieties, *e. g.*, Bartlett, Comice, Anjou, Howell and Bose, picked before they attain a size of  $2\frac{1}{4}$  inches or more. In fact, most growers aim to pack nothing that does not measure at least  $2\frac{1}{2}$  inches through the widest part of the shorter axis. As it is rather difficult, for inexperienced pickers at least, to gauge the sizes properly, especially early in the season when picking begins, a piece of heavy wire curved into a ring at both ends is used. One ring measures  $2\frac{1}{4}$  inches and the other  $2\frac{1}{2}$  inches. The picker carries this device and by placing either one or the other end against the fruit can determine very accurately the proper size to pick. If he is instructed to pick  $2\frac{1}{4}$ -inch pears and over, everything that will pass through the  $2\frac{1}{4}$ -inch ring is left on the trees and the fruit that will not pass through is picked. In case he has instructions

to pick 2½-inch pears it is simply necessary to use the other end of the ring.

Pears of the Bartlett variety are picked while to all outward appearances they are perfectly green. It has been the contention of leading Bartlett pear growers of California for years, that this variety is ready to pick as soon as it attains a size of from 2¼ to 2½ inches. Their contention is partially borne out by an experiment carried on cooperatively between the Department of Chemistry of the University of California and the State Commission of Horticulture.\* In 1916 samples of pears were collected in three different counties of the state, viz: Placer, Contra Costa and Sacramento, at different times throughout the ripening season. The samples were tested for sugar and acid when received at Berkeley, and were then placed in storage and again tested after ripening. It is not necessary to go into details regarding this experiment here; suffice it to say that the earliest picked fruit, which seemed perfectly green when packed and shipped, ripened well and proved to be practically, if not wholly, as good as fruit that was left on the trees until practically ripe. In this respect the pear differs strikingly from other fruits, and even though picked when the amateur would certainly condemn it as being unfit for human consumption, the changes which it undergoes after picking result in an increase of sugar, and as the fruit colors a beautiful yellow, and remains solid without any shriveling, in addition to having a good flavor, there can be no objection to picking it. Just how green it can be removed from the trees and still ripen satisfactorily is a question that is yet to be determined. No doubt in time there will be some test other than that of size that will govern the time of picking so that fruit may be at its very best when packed. The experiment mentioned was conducted with pears of the Bartlett variety and therefore does not apply to any other sort.

After removing the fruit from the trees in the manner described it should be carefully deposited in the picking sack, bucket or receptacle used by the pickers. Careless pickers are apt to injure fruit so that it will deteriorate quickly after packing and much stress should be laid on careful handling. From the picking receptacle the pears are placed in picking boxes, a supply of which should be conveniently located with respect to the pickers.

The loaded picking boxes, which are filled to a height just below the top so that they can be stacked one upon the other without bruising the fruit, are hauled to the packing sheds on low iron-wheeled or other suitable wagons or sleds. In the packing shed they are stacked, one upon the other, to a convenient height and conveniently located with respect to the sorting and packing tables. The wise grower will place much stress upon the convenience in arrangement of his packing shed. Boxes are somewhat heavy to move and every step that can be saved in their handling increases the returns to the grower.

#### GRADING.

It will be seen from the description given of the picking of Bartlett pears that grading is really done in some cases at the time of picking. In the latter part of the season, however, when all the fruit is ready

\*Article by W. V. Cruess, Monthly Bulletin, State Commission of Horticulture, Vol. 5, No. 12, page 425.

to be picked, trees will be stripped of everything and there is no attempt made at grading in the orchard. Such fruit should be graded in the packing house, and now that the "Fresh Fruit Standardization Law" requires packed fruit to be "practically uniform" in size, grading is absolutely necessary if the law is to be obeyed. Mechanical graders have been little used for pears in California, the work being done by hand almost entirely. Packers become very expert in grading and without the use of rings can perform the work quickly and accurately when they once become accustomed to the sizes that they are expected to select.

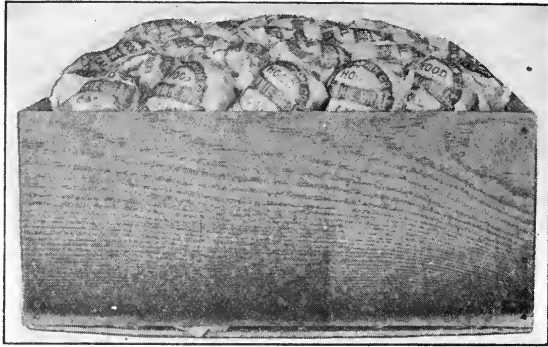


FIG. 179. Well-packed box of pears.

#### PACKING.

Pears are packed in boxes 18 inches long,  $11\frac{1}{2}$  inches wide and  $8\frac{1}{2}$  inches deep. The number in a box varies according to the size and pack. The arrangement of the pack is shown in Fig. 179. Each pear is wrapped neatly in a piece of paper and placed firmly but carefully in the box. A good packer nests every pear in such a way that there is no chance for its moving about in the pack. Solidness is the princi-

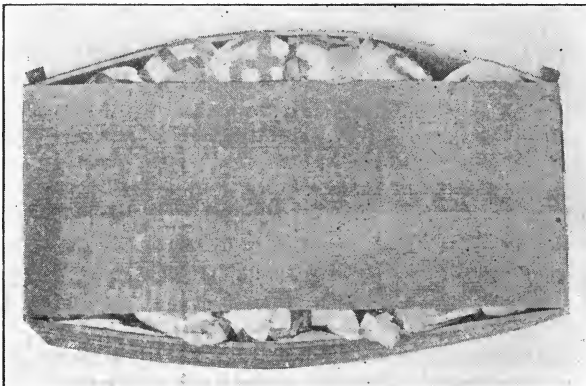


FIG. 180. Packed box of pears showing the ordinary excessive bulge.



pal requisite of a good pack, as fruit when being handled or hauled in wagons or cars after packing, must not have a chance to move about in the pack, for if it does the rubbing will cause bruising and result in injuring or entirely spoiling the fruit. In order to do away with any possibility of looseness in the pack, California pear growers, in fact pear growers in all the Western states, have possibly gone to the extreme in the amount of fruit placed in a box. Fig. 180 shows a bulge such as is commonly seen on pear boxes. This bulge often measures three inches at the point of greatest distention on the top, and on the bottom there is a bulge which is nearly as great. That such a bulge is not necessary is the opinion of many practical fruit men. Too frequently the pressure necessary to put a cover on a box of fruit packed like that shown in Fig. 180 results in appreciable injury by bruising a large percentage of the pears in the box. Instead of a three-inch bulge, a  $\frac{3}{4}$ - or 1-inch bulge is all that is necessary and no doubt in time the evils of the present excessive bulge pack will be corrected. It must be borne in mind, however, that too slack a pack is more liable to be injured in transportation than the tight pack, and there must be enough pressure of the cover upon the fruit to hold each piece in place.

On one end of the packed box of pears an attractive label, usually lithographed, is used. This label is required by law to have printed on it the variety, the name and address of the packer, and the name of locality where the fruit was grown. In addition, the minimum net weight must be stamped on this label. This weight is generally put at 45 pounds. Most of the boxes, however, weigh more than 50 pounds. Growers have particular brands of their own which are also indicated on the label. Under the terms of the standardization act passed by the legislature in 1917, pears when packed shall be practically free from insects and fungous diseases and shall also be of practically uniform size, quality and maturity.

It is hard to estimate the value of the new standardization law. It is safe to say, however, that since it became effective there has been a decided improvement in the pear pack in many sections of California. The wording of the law is possibly a little weak and somewhat indefinite, making it necessary for the horticultural commissioner to define certain terms which, if defined in the law, would make his work much easier and more effective. For example, "practically free" from insects and fungous diseases is not interpreted the same by all inspectors. It is generally conceded that "practically" should mean that not more than 3 per cent of the fruit is infested, and that when it applies to size the variation should be not greater than  $\frac{3}{8}$  of an inch. A precedent for this ruling which has been adopted by some of the horticultural commissioners is found in the apple standardization act. There have been many difficulties in the way of enforcing this new law but as time goes on these difficulties will disappear and eventually the standardization law will mean much to the pear industry as well as to the other deciduous fruit industries of California.

## CHAPTER XVI.

## CANNING AND DRYING PEARS.

## THE CANNING INDUSTRY.

The Bartlett pear is particularly fine for canning purposes and California may justly be proud of the quality of the large amount of canned fruit that goes into the markets each season. The pear canning industry has assumed a position of great importance in the state, and the pear grower is generally assured of good prices for his fruit whether or not the market for the packed product is satisfactory. The canning companies pay from \$30 to \$50 per ton for suitable pears, often making contracts for five years or more, by which they agree to pay a certain price each year for the entire crop of an orchard, or for a specified number of tons of a certain size and grade.

Pears for canning should be at least  $2\frac{1}{2}$  inches in diameter, the larger sizes always being preferred. Fruit smaller than  $2\frac{1}{2}$  inches is generally rejected by the canners. It is a common practice for the growers to pack their pears during the early part of the season, and later, when there is apt to be somewhat of a slump in the market for fresh fruit, everything is sold to the canneries. In this way an entire crop may be sold to good advantage which, if only the market for fresh fruit was available, would often bring poor returns.

In the modern cannery, fruit is handled in a careful and sanitary manner, so that the one time objection to canned goods because of the filth that often surrounded the canning is eliminated and there need be no more fear for the cleanliness of the fruit than if it had been prepared in the kitchen of the most careful housewife. Both the canning and the drying business are very important and act as a sort of a "safety valve" for the industry; much fruit that is not fit for packing can be utilized to good advantage for drying or canning. In this way it is possible to conserve all except very low grade fruit and at the same time the profits to the growers are satisfactory.

## DRYING PEARS.

The dried pear industry has become exceedingly important in Lake County, where, during 1917, 3,981 green tons were dried. While Lake County leads all other counties in the production of dried pears, the industry is by no means confined to this county. In Contra Costa, Solano, Napa, Sonoma and Mendocino counties there is always more or less fruit dried each season, while still other counties dry in small amounts. The great difference, however, between the industry in Lake County and all others where pears are dried lies in the fact that the Lake County orchards are remote from a railroad shipping point (30 miles or more) and consequently the entire output of certain fine orchards is dried, while in counties where transportation facilities are good the best pears are usually packed or sold to the canneries, and only the culls are dried.

### DRYING CULLS.

In connection with the drying of culls it is unfortunate that too frequently the work is done with little care, and the extremely poor grade fruit, often unfit for consumption, is dried under conditions that are not sanitary and a very poor product is the result. In making a trip in 1915 through some of the counties mentioned, the writer was impressed with the fine grade of certain fruit and it must be admitted very much disgusted with the poor grade of other fruit which, in the first place, was half rotten and not fit to dry, and which, in the second place, was being dried by Orientals in the midst of dust, flies and filth of all kinds which had a tendency to take away all of one's

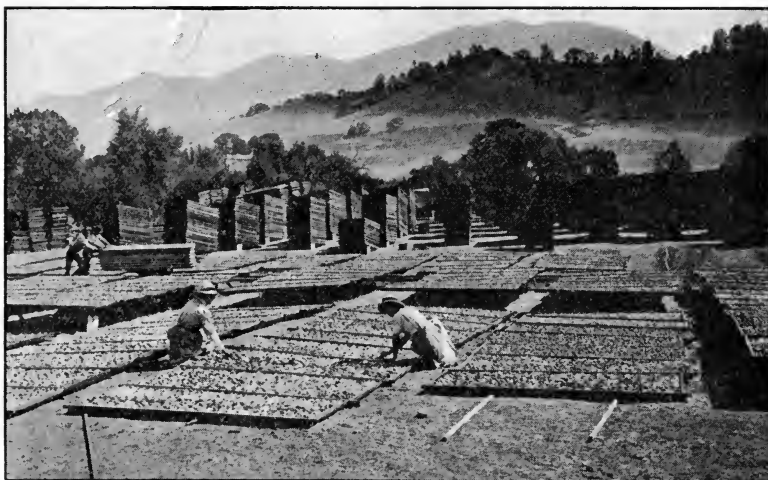


FIG. 181. Culling pears from the drying trays.

appetite for dried pears. The dried pear, when properly prepared, is a fine product, and the kind that Lake County produces, when rightly cooked, compares favorably with any other kind of dried fruit, and were it not for the poorer class of fruit that is being treated in the manner described, the product, as a whole, would become much more popular.

The market for dried pears could undoubtedly be increased greatly by the elimination of the poorer grades, or by a system of standardization whereby the product could be better graded, making it possible for the consumer to buy good pears even though at a much higher price, instead of the exceedingly poor trash that we are in the habit of seeing in our grocery stores, and which is anything but conducive to the sale of the product. Europe has given us our market in the past and Europeans in America have consumed most of our dried pears. In order to educate the American people to eat this delicious fruit, it will be necessary to supply them with an article that is attractive and that they may know has been handled in a careful, sanitary manner.

**PICKING.**

Pears for drying purposes are picked before ripe, and stored in bins or boxes for a week or ten days before cutting. They are picked by hand, although windfalls are utilized except portions that are too badly bruised. To prevent bruising straw is sometimes spread under the trees, and the windfalls, as well as pears knocked off in picking are not liable to be injured. The fruit when picked is placed in the ordinary picking boxes, and hauled to the drying yards, where it is culled and graded for size in some cases and in others is left until cut and drying upon the trays before culling is done. See Fig. 181.

The following facts regarding the details of the drying process in Lake County are gleaned mostly from an article\* by Fred G. Stokes,



FIG. 182. Close view of stacked trays containing pears in the process of drying.

County Horticultural Commissioner of Lake County, who is a pear grower and who possesses a minute knowledge of the business gained throughout years of investigation and practical experience.

**CUTTING.**

For convenience the larger drying yards are equipped with small cars run on tracks located conveniently for handling the fruit. The pears are carried in lug boxes by these cars to the cutting shed where the cutters, usually women of the neighborhood, are employed, and paid at the rate of ten cents for a 50 pound box. The wages paid at this rate range from \$2 to \$3.50 per day.

The pear should be cut over-ripe in order that it may dry with the least possible shrinkage. The operation consists of cutting the fruit in half with a knife and removing the stem and calyx with a corer.

\* "The Dried Pear Industry," by Fred G. Stokes, County Horticultural Commissioner, Kelseyville, California Monthly Bulletin, Vol. VI, No. 5, Proceedings Forty-ninth State Fruit Growers' Convention, Napa, California, Nov. 15, 16, 17, 1916.

If fruit is wormy or otherwise injured it may be necessary to remove the core, otherwise it is left. Milk pans are used as receptacles to hold the cut fruit. From these the halves are placed cut side up on the drying trays. These are purchased for about 50 cents each, are made preferably of pine, and the dimensions are as follows: 8 feet by 3 feet, or 8 feet by 30 inches.

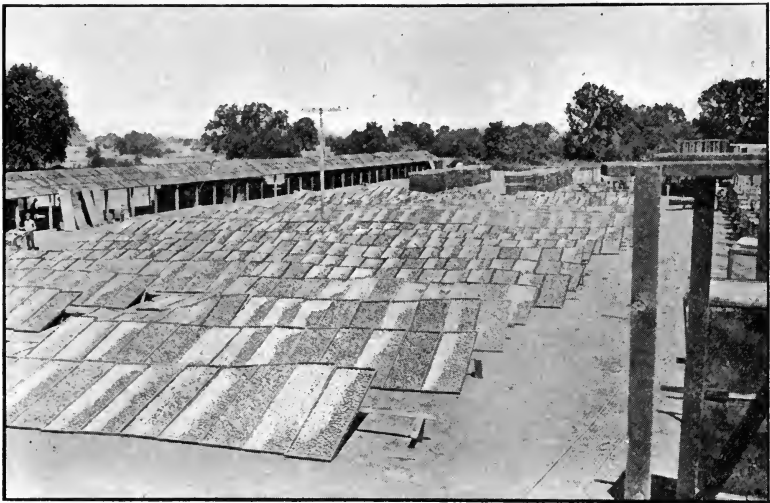


FIG. 183. Large pear-drying yard with trays containing cut pears inclined toward the sun to facilitate drying.

#### SULPHURING.

Pears, like all others of our dried fruits, are bleached by means of sulphur fumes. This gives them a clear, more or less transparent appearance, greatly adding to their attractiveness and sale. In addition the sulphur gas acts as a sterilizing agent to prevent decay and as an insecticide or repellant to kill or drive away any insect life which might be present.

#### SULPHUR HOUSES AND BALLOONS.

A type of concrete sulphur house used in Lake County is shown in Fig. 184. This house is roomy and suitable for work on a large scale. The tracks referred to previously may be seen running into this house, and a car upon which are trays of fruit ready to be unloaded and sulphured may be seen also. Fig. 185 shows the ordinary type of balloon hood that is effectively used by many of the pear dryers. They have the advantage of being cheaper than the concrete houses. These hoods consist of a light wooden framework, covered with two or three-ply roofing paper. The long row of hoods shown in Fig. 185 are raised from and placed over the trays by means of a block and tackle on a suitable running gear above. Thus one tackle may perform the work of many hoods.

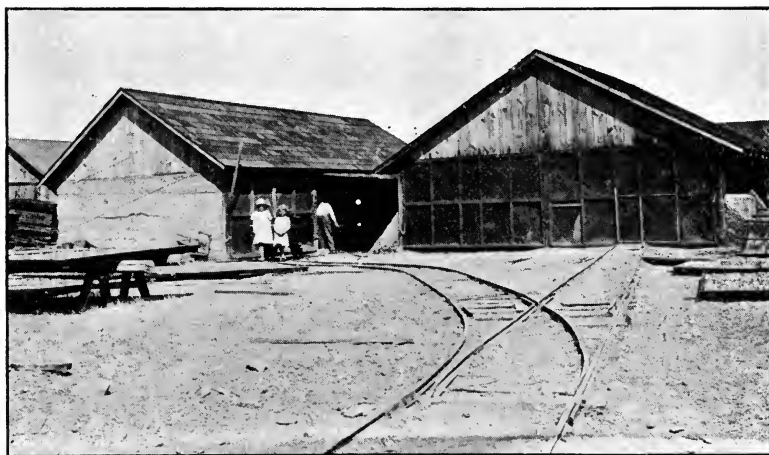


FIG. 184. Concrete houses for sulphuring dried pears.

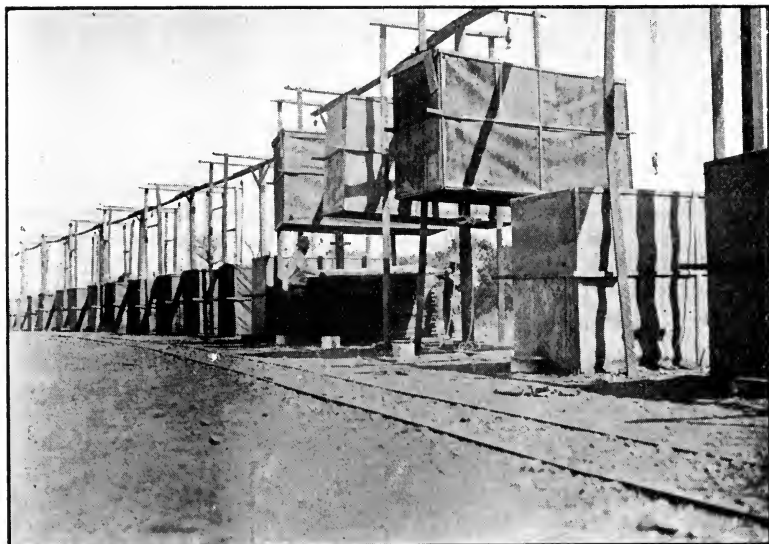


FIG. 185. Balloon hoods used for sulphuring dried pears.

**COOKING DRIED PEARS.**

Dried pears have not yet become popular in this country and it has been necessary to depend on a European market. Like other dried fruits they must be cooked properly to bring out the flavor. With proper cooking there is no more delicious dried fruit than pears. The following recipe\* is worthy of trial by every housewife who discounts the value of this delicious fruit.

“Wash the fruit clean and simmer for half an hour. By that time the pears will have swollen to almost original size, but will not have softened so as to fall to pieces. If you keep them stewing they will become too soft. Take the pears out; lay them in a shallow dish or pan, strain the water back over them, sprinkle them with sugar, flavor if you wish with spice to taste, and bake fifteen minutes. They will come out of the oven nicely baked, with the sugar crystallized on the surface. Serve with cream and you have a dish that everybody enjoys. Dried pears, according to analysis, are one of the most nutritious of fruits, and at the same price per pound have a greater food value than dried apples.”

---

\*Article by Frank T. Swett on “Dried Pears and Other Things,” Monthly Bulletin, Vol. VI, No. 5, page 127.

## CHAPTER XVII.

## INSECTICIDES AND FUNGICIDES.

The treatment of pear trees for the various insect pests and diseases that affect them at certain times requires the use of a number of different kinds of insecticides and fungicides. These, with formulæ, methods of preparation and general directions for use, are discussed.

## CONTACT INSECTICIDES.

Lime-sulphur (commercial).  
 Lime-sulphur (homemade).  
 Nicotine (tobacco decoction, sulphate of nicotine, tobacco dust, etc).  
 Kerosene emulsion.  
 Distillate emulsion.  
 Crude oil emulsion.  
 Miscible oil.  
 Sulphur (sublimed, atomic, milled, soluble, etc).  
 Whale-oil soap (fish oils).  
 Caustic soda.  
 Distillate emulsion and tobacco (Government pear thrips formula).

## POISONOUS INSECTICIDES.

Arsenate of lead.  
 Paris green.  
 Arsenite of zinc.

## FUNGICIDES AND GERMICIDES.

Bordeaux mixture.  
 Lime-sulphur (commercial).  
 Lime-sulphur (homemade).  
 Lime-sulphur (self-boiled).  
 Sulphur (sublimed, atomic, milled, soluble, etc.).  
 Bichloride of mercury.  
 Formalin.

## FUMIGANTS.

Hydrocyanic acid gas.  
 Carbon bisulphide gas.

## REPELLANTS.

Bordeaux mixture.  
 Whitewash.  
 Lime-sulphur.





FIG. 186. The pears and leaves in this picture show the very even distribution of arsenate of lead, indicating a thorough job of spraying.

#### SPRAY FORMULÆ.

##### No. 1. Lime-Sulphur—Commercial.

Practically every insecticide company manufactures lime-sulphur, consequently there are a great many different brands of this material on the market, most of which are good. It is prepared, as a rule, in the form of a liquid, although recently a powdered lime-sulphur has been put on the market. This form has not yet been used extensively enough so that it can be recommended. The liquid lime-sulphur is diluted for use on pear trees while they are dormant by adding to 1 gallon of the

liquid 10 gallons of water. For summer use on pear trees it should not be used stronger than 1 gallon of lime-sulphur to 35 gallons of water.

#### No. 2. Lime-Sulphur—Homemade.

Stone lime -----	80 pounds
Sulphur -----	60 pounds
Water -----	200 gallons

#### Preparation.

Bring about 50 gallons of water to a boil in some suitable vessel, or a sufficient amount for slaking the 80 pounds of lime. Add the sulphur and mix as well as possible with the water. When the water is hot, carefully put in the lime, which will slack almost instantly with the generation of a great amount of heat. This is desirable, as it helps effect a combination of the lime and sulphur immediately. The mixture must be boiled for at least 45 minutes. When finished, the liquid is a bright red color, often turning olive green upon further boiling. There is no danger of boiling too long, but on the other hand too little boiling may be responsible for a poor product. Dilute with a sufficient quantity of cold water to make 200 gallons of the spray. Lime sulphur is one of our best insecticides as well as fungicides.

#### No. 3. Nicotine (Tobacco Decoction, Sulphate of Nicotine, Tobacco Dust, etc.).

For the various plant lice which affect pears there is nothing better to apply during the summer season than nicotine, commonly used in the form of a sulphate. It is sold under the names of nicotine sulphate and Black Leaf "40." It is generally applied at the strength of 1 part of water to 1,000 parts of nicotine sulphate. The addition of 3 pounds or more of soap (whale oil or other good liquid fish oil soap is desirable) to 100 gallons of the diluted spray adds to its efficiency. In combination with distillate emulsion, 3 per cent strength, it is used for the control of pear thrips. A decoction of tobacco is made by steeping stems and leaves in water about the boiling point; it must not boil as nicotine volatilizes readily. Tobacco dust very finely ground is used for root forms of aphids and is sometimes dusted on trees infested with plant lice.

#### No. 4. Kerosene Emulsion.

Water -----	1 gallon
Kerosene -----	2 gallons
Hard soap -----	1 pound

#### Preparation.

Bring the gallon of water to a boil and dissolve the soap in it. While hot add the kerosene, agitating the mixture violently for fifteen minutes or more. A cream-like emulsion should be formed, which will mix readily with cold water. A stock solution, containing 66 $\frac{2}{3}$  per cent oil, is obtained by this process and may be diluted to any desired strength. Larger quantities are prepared by using the same materials in a like proportion. A simple method for diluting to any desired strength is as follows: Divide 200 by the per cent desired and subtract 3. This will give the amount of water necessary to add to each 3 gallons of stock solution for the desired per cent. For example, a 15 per cent solution

is desired; 200 divided by 15 equals  $13\frac{1}{3}$ , minus 3 equals  $10\frac{1}{3}$ ; this amount of water added to 3 gallons of stock solution will give the 15 per cent emulsion.

#### No. 5. Distillate Emulsion.\*

Distillate (28° Baumé) -----	20 gallons
Whale oil soap -----	30 pounds
Water to mix -----	12 gallons

#### Preparation.

Dissolve the whale-oil soap in the water, heating it to the boiling point; add the distillate and agitate thoroughly while the solution is hot. For use add from 10 to 20 gallons of water to each gallon of the above mixture.

#### No. 6. Crude Oil Emulsion.\*

Water -----	175 gallons
Liquid soap -----	3 gallons
Crude oil -----	25 gallons

#### Preparation.

Fill the spray tank with the 175 gallons of water; add the liquid soap; agitate thoroughly for one minute, after which add the crude oil, continuing the agitation.

If the liquid soap can not be had, use 20 pounds whale-oil soap, dissolved in 10 gallons of boiling water, to which 3 pounds of lye have been added.

#### No. 7. Miscible Oil.

The so-called miscible oil sprays are becoming very popular for use in deciduous orchards that are infested with scale insects, leaf roller, etc. Practically all insecticide companies handle miscible oils, which are generally diluted with 10 parts of water for dormant use. When properly made the emulsion which results after mixing with water is milk-like, there being practically no separation of the oil from the ingredients of the emulsion. If the milk-like consistency is not present after mixing, it is usually because of hard water, in which case it is necessary to use lye (caustic soda) in order to soften the water.

#### No. 8. Sulphur (Sublimed, Atomic, Milled, Soluble, etc.).

As an insecticide and fungicide sulphur is quite generally used in one form or another. In the case of pear trees it may be used for mites as it is the standard remedy for these pests. Frequently the sublimed sulphur is dusted upon infested trees and, when weather conditions are right, with good results. Any of the forms known as atomic, milled, or soluble sulphur can be used with splendid results. These are conveniently mixed with water and, generally speaking, are preferable to sublimed sulphur.

#### No. 9. Whale-Oil Soap (Fish Oils).

This soap is often used in combination with nicotine sprays, to increase their penetration and spreading qualities. Alone as a spray

\*Copied from "Injurious and Beneficial Insects of California," by E. O. Essig.

for aphids it is very valuable, when used at the strength of 1 pound of soap to 5 gallons of water.

The ordinary form of this soap has to be melted before being used. There is, however, a liquid form on the market which is much more conveniently handled. Fish oils are used in the manufacture of soaps for spraying purposes and may be substituted for whale-oil soap.

#### No. 10. Caustic Soda.

This material can not be considered as an insecticide; however, it is used frequently in breaking hard water in order that oil emulsion sprays may make perfect emulsions when mixed with water. It also has considerable value in killing moss or lichens on fruit trees. Three pounds of caustic soda to 100 gallons of oil spray will remove moss from pear trees that have been neglected and where it has consequently become abundant.

#### No. 11. Distillate Emulsion and Tobacco.\*

(Government Formula for Pear Thrips.)

Water -----	12 gallons
Whale oil soap-----	30 pounds
Distillate (32° to 34° Baumé)-----	20 gallons

The above emulsion is prepared in the ordinary way as a stock solution. For use in the orchard dilute one to twenty parts of water. To every two hundred gallons of this diluted spray add one pint of tobacco extract containing forty per cent nicotine or about three and one half gallons of tobacco extract containing  $2\frac{3}{4}$  per cent nicotine.

This spray is especially recommended for pear thrips.

#### No. 12. Arsenate of Lead.

This is the most commonly used arsenical spray in the pear orchard and the commonly used strength is 3 pounds of paste to 50 gallons of water, or  $1\frac{1}{2}$  pounds of the powdered form of arsenate of lead to 50 gallons of water. This amount is sufficient for the control of codling moth, canker worm, tent caterpillar, pear slugs and other larvæ which feed upon foliage and fruit. Half of this amount will suffice for the calyx application in spraying for the control of codling moth.

#### No. 13. Paris Green.

In the past this arsenical poison has been very extensively used in spraying for the control of chewing insects, but its use has been superseded by the safer and generally better arsenate of lead. For codling moth and other chewing insects it should be applied at the strength of  $\frac{3}{4}$  pound to 100 gallons of water. On account of the likelihood of there being more or less soluble arsenic in the Paris green, which may blight the foliage, lime in small quantities should always be added to the spray. Five pounds of stone lime, slaked, to every 100 gallons of liquid is sufficient.

#### No. 14. Arsenite of Zinc.

The above is one of the newer arsenical insecticides manufactured by the California Spray Chemical Company of Watsonville. It gives

\*Copied from "Injurious and Beneficial Insects of California," by E. O. Essig.

splendid results in killing certain insects which are more or less resistant to arsenate of lead poisoning, as well as all those for which the arsenate of lead is used. This is a less stable compound than arsenate of lead and for that reason considerable damage has been done to the foliage and fruit of trees to which it has been applied. It is recommended only for the calyx application for codling moth on apple trees and no doubt would also be effective in the case of pears.

#### No. 15. Bordeaux Mixture.

Copper sulphate .....	20 pounds
Stone lime (unslaked) .....	20 pounds
Water .....	200 gallons

#### Preparation.

The copper sulphate is first dissolved by suspending the weighed amount in a sack in a sufficient quantity of water. The lime is slaked in an equal amount of water and the two liquids containing the dissolved materials poured together into the spray tank, where the agitator will keep the liquid properly mixed. Bordeaux may now be purchased in the form of a paste ready for dilution with water. The convenience of this form, though it is more expensive than the home-made product, is fast making it popular. Bordeaux is one of the older fungicides and is by many rated as the best that has ever been discovered for general fungicidal purposes.

#### No. 16. Lime-Sulphur—Self-Boiled.

Stone lime .....	8 pounds
Sulphur .....	8 pounds
Water .....	50 gallons

#### Preparation.

The preparation differs from that of the home-made, boiled lime-sulphur in that only the heat of the lime, which is generated during the slaking process, is utilized. It is made in a barrel or tank, which may be covered tightly to retain the heat for about 15 or 20 minutes, when a slight amount of sulphur and lime will have combined. It is diluted with cold water, after being strained.

In some of the states to the east the self-boiled lime-sulphur alone or in combination with arsenate of lead has been used very successfully in the control of scab but has not been generally recommended under California conditions.

#### No. 17. Bichloride of Mercury.

Corrosive sublimate, (bichloride of mercury), is used extensively in pear blight work for disinfecting tools and wounds made in the removal of blight from affected trees. It may be purchased from druggists in the form of tablets, one tablet dissolved in a pint of water making a 1 to 1000 solution.

#### No. 18. Formalin.

Formalin is sometimes used in place of bichloride of mercury as a disinfectant, but is not recommended for disinfection work in connection with pear blight control.

**No. 19. Hydrocyanic Acid Gas.**

This gas is generated by the treatment of either potassium or sodium cyanide with dilute sulphuric acid in the proportions of 1 ounce of potassium cyanide, 1 fluid ounce of sulphuric acid and 3 fluid ounces of water or  $\frac{3}{4}$  ounce sodium cyanide with  $1\frac{1}{2}$  fluid ounces of sulphuric acid and 2 fluid ounces of water. It is necessary to confine this gas in a tight box or house in order to get results. It is very light and rapidly dissipates in the air unless confined. It is very valuable in the fumigation of pear trees that are affected with root aphids or scale insects. Being extremely poisonous, the greatest care must be exercised in its use. It is generated usually in an earthenware jar, the water being first put in the jar and the sulphuric acid then poured into the water, after which the weighed amount of cyanide necessary for the particular building is dropped into the solution, with the resultant formation of the hydrocyanic acid gas.

**No. 20. Carbon Bisulphide Gas.**

This gas is sometimes used with nursery stock instead of hydrocyanic acid gas. Being much more expensive and in most cases less effective than the hydrocyanic acid gas it is not generally recommended for use in the fumigation of nursery stock. The gas is very heavy, flowing like water, and if used it must be remembered that it is so heavy that it will settle to the bottom of any box or house in which it is used. Thus it becomes necessary to use a sufficient amount to practically fill the box or house, providing that same is filled with trees.

**No. 21. Whitewash.**

Wickson\* recommends the following formula for whitewash:

Lime -----	30 pounds
Tallow -----	4 pounds
Salt -----	5 pounds
Water sufficient to make it flow well.	

In cases where rabbits are troublesome to trees the salt should be eliminated, as it has a tendency to attract the rabbits, which frequently injure the trees by eating the bark from the trunks. In place of salt it would be well to use a small amount of commercial aloes dissolved in the whitewash, as this material is exceedingly distasteful to rabbits. One pound of aloes to 5 gallons of whitewash would be sufficient to give good results.

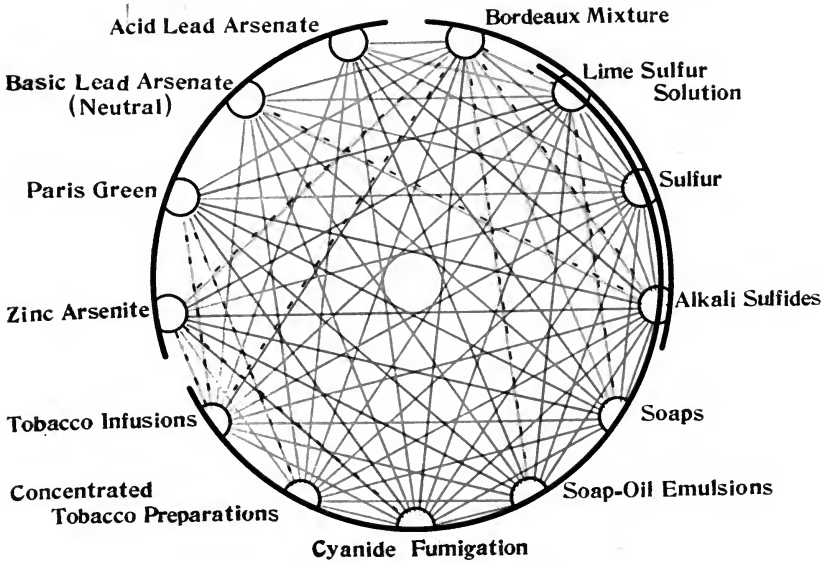
**MIXING INSECTICIDES AND FUNGICIDES.**

The pear tree is subject to the attack of so many different kinds of insect pests and diseases that at times it is practical and economical to mix certain insecticides in order that more than one pest may be controlled, or to mix an insecticide and a fungicide in order that certain insect pests and fungous diseases may be controlled. For example, it is always customary in sections where pear scab and codling moth are troublesome on pears to mix arsenate of lead with Bordeaux mixture,

\* "California Fruits," seventh edition, page 85.

STOMACH POISONS

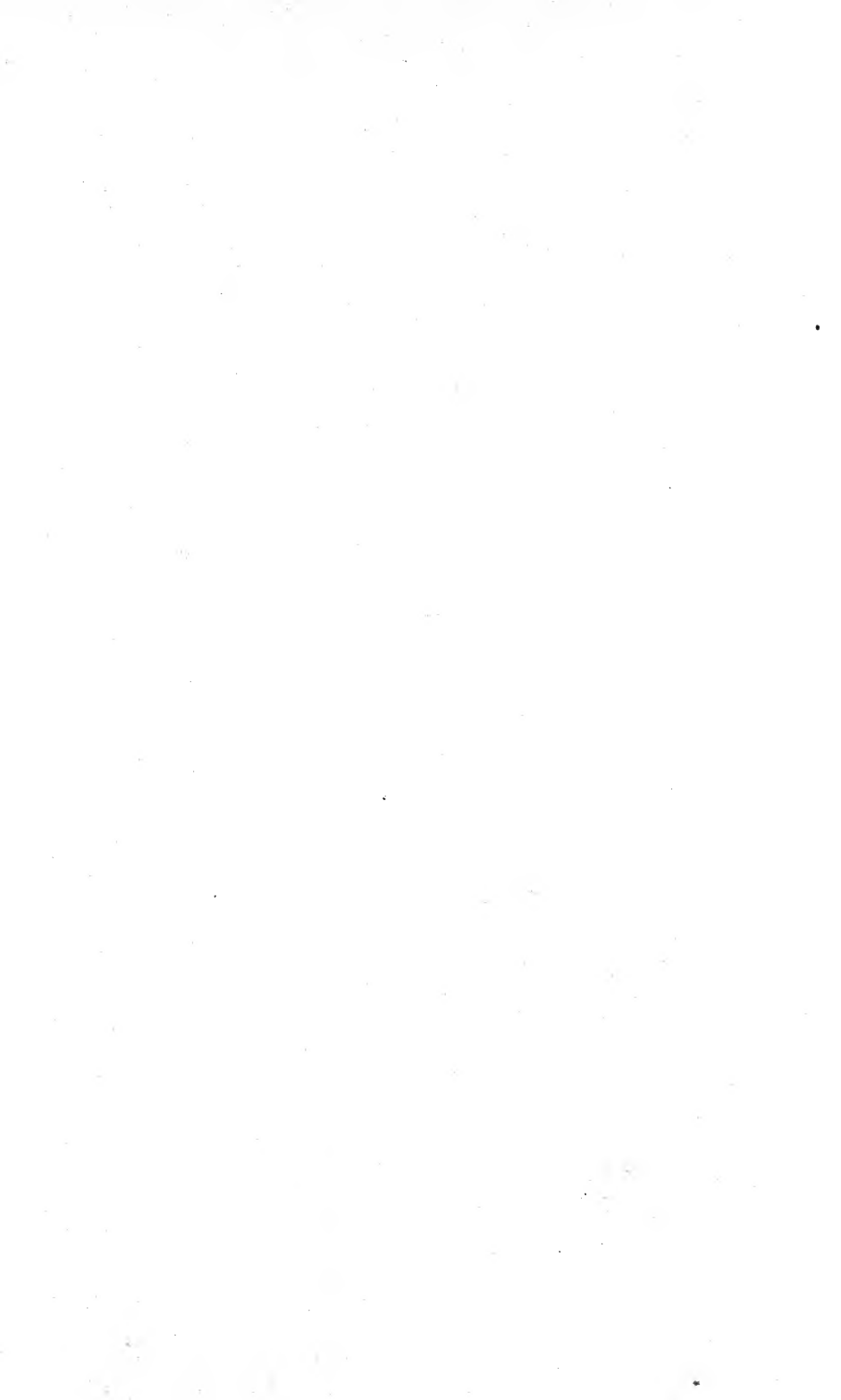
FUNGICIDES



TRACHEAL POISONS

KEY TO CHART:

- |       |   |       |                    |
|-------|---|-------|--------------------|
| ————— | Dangerous combinations                              | ----- | Data lacking:      |
| ===== | Recommended combinations                            | ----- | Probably dangerous |
| ----- | Doubtful combinations, useful under some conditions | ----- | Probably safe      |
|       |   | ----- | Doubtful           |





atomic sulphur or some other good fungicide in the early spring when the first application is made for codling moth just as the blossoms have dropped. By going over the orchard once at this time with this combined spray both scab and codling moth are controlled.

Professor George P. Gray, Chemist, Insecticide and Fungicide Laboratory of the University of California, has prepared a compatibility chart of insecticides and fungicides which shows at a glance which may be mixed with safety, which are dangerous combinations, which are doubtful, etc. It is believed that this chart will be exceedingly valuable to the pear growers of California and it is therefore being used in connection with this article. Professor Gray printed this chart originally in Circular No. 195, March, 1918.

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